

UROLOGY

BY

DANIEL N EISENDRATH, M D

CONSULTING UROLOGIST TO THE AMERICAN HOSPITAL, PARIS, FRANCE, FORMERLY
ATTENDING UROLOGIST, MICHAEL REEF, AND COOK COUNTY HOSPITALS,
ASSISTANT PROFESSOR OF SURGERY (GENITO-URINARY), RUSH
MEDICAL COLLEGE OF THE UNIVERSITY OF CHICAGO

AND

HARRY C ROLNICK, M D

ATTENDING UROLOGIST, MICHAEL REEF, ST. SINAI AND COOK COUNTY
HOSPITALS, CHICAGO, FORMERLY CLINICAL PROFESSOR OF
UROLOGY, LOS ANGELES UNIVERSITY MEDICAL CENTER

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PREFACE TO THE FOURTH EDITION

Our aim in this book has been to simplify the subject of urology for teaching purposes. The reception given to previous editions is an ample endorsement of our efforts. Many improvements in both diagnostic and therapeutic methods have been made since publication of the third edition only four years ago necessitating a complete revision of our text. A large number of illustrations in previous editions have been replaced by others most of which are original. We have retained the former division of chapters according to individual components of the urinary tract as applied to both sexes and those of the male genital tract. We believe that such a division or classification is easier for the student to follow than that employed in some text books of taking up anomalies, injuries, diseases and neoplasms according to systems such as obstructive uropathy etc.

Excretory urography as a diagnostic method has been discussed in an impartial manner, to point out its advantages and drawbacks. The six chapters on Gonorrhea in the Male have been rewritten so as to form only two chapters in the present edition. However, this subject is fully covered. We are indebted to Dr Irving F. Stein for a revision of the chapter on Gonorrhea in the Female. Many new illustrations have been added to the chapters on early syphilis and venereal ulcerations. We have included the newer studies of the male sex hormones and their employment together with that of the gonadotropic principle found in urine in both diagnosis and treatment. We have stressed in this edition as in the previous editions the importance of the study of the male genital tract.

The growing importance of cystometry in the diagnosis of neurologic dysfunction of the bladder has led us to ask Dr Maurice Muschat who has had a large experience in this field to present this subject. The chapter on 'Tumors of the Bladder' has been revised so as to bring the question of treatment in line with present-day methods. The relation of injuries of the ureter to gynecological operations is fully discussed in Chapter 30 as is also an evaluation of strictures of nonoperative origin a subject in which there has been recently a marked change in opinion as to their incidence.

The inclusion of adrenal hyperplasia and neoplasms in the field of urologic surgery has necessitated as complete a discussion of the diagnosis and operative technic as was believed necessary for text book purposes. The chapters on 'Non-tuberculous and Tuberculous Infections, Nephrolithiasis and Renal Tumors' have been rewritten to include recent changes in our viewpoints on the etiology, diagnosis and treatment of the conditions included in these chapters. In former editions only the surgical aspects of nephritis were taken up but a knowledge of the medical aspects has become indispensable for the urologists and is therefore fully discussed in Chapter 44. The constantly increasing importance of urology in the female and in children has convinced us of the necessity of devoting special chapters to them instead as is customary in most text books on urology of placing them as appendices to other chapters. In the chapters on 'Diseases' and in that on 'Operations on the Prostate' the subject matter has been revised in the light of the recent addition to our methods of treatment by trans urethral resection. The former chapters on 'Technique of operations on the kidney and ureter' have been combined into a single one 'Special

attention has been given in this chapter to the sections on muscles, etc , to be divided in exposing the kidney or ureter , to adding a large number of illustrations of different types of ureterotomy incisions and to descriptions of the technic of total nephroureterectomy, pyeloplasty, resection of the renal pelvis, implantation of the ureter, etc

We wish to express our appreciation of the work of Dr Walter W Baker in reading the proof and to the publishers for their co-operation

THE AUTHORS

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CONTENTS

PART ONE

STRUCTURE FUNCTION NON-OPERATIVE TECHNIQS

CHAPTER	PAGE
1 EMBRYOLOGY	3
DEVELOPMENT OF THE KIDNEY AND URETER	3
COMPARATIVE EMBRYOLOGY	3
DEVELOPMENT OF THE PERMANENT KIDNEY AND URETER IN MAN	4
CHANGE IN POSITION OF THE KIDNEY DURING DEVELOPMENT	6
DEVELOPMENT OF REPRODUCTIVE GLANDS AND THEIR DUCTS	7
UNDIFFERENTIATED GLANDS	7
DIFFERENTIATION INTO MALE AND FEMALE TYPES	7
THE GONADS	7
MALE	8
FEMALE	9
DESCENT OF THE TESTES	9
DEVELOPMENT OF THE BLADDER	11
DEVELOPMENT OF THE URETHRA AND ITS ACCESSORY GLANDS	11
TRUE URETHRA	11
UROGENITAL SINUS	12
ACCESSORY GLANDS	12
DEVELOPMENT OF THE EXTERNAL GENITALIA	14
DEVELOPMENT OF SEMINAL VESICLES EJACULATORY DUCTS AND VAGINA DIFFERENTIA	15
2 ANATOMY	16
THE KIDNEYS	16
LOCATION	16
FIXATION OF THE KIDNEYS	18
RENAL FASCIA	19
PERI AND PARARENAL FAT LAYERS AND THEIR RELATION TO THE RENAL FASCIA	19
CLINICAL APPLICATION	20
FORM AND SIZE OF THE KIDNEY	21
STRUCTURE OF THE KIDNEY	23
RENAL PARSCHYMA	25
VASCULAR AND LYMPHATIC SUPPLY OF THE KIDNEY	27
INNERVATION OF THE KIDNEY	30
THE URETER	32
DIVISIONS	33
RELATION OF ABDOMINAL (LUMBAR AND PELVIC) URETERS	33
THE PELVIC PORTION OF THE URETER	34
STRUCTURE OF THE URETER	35
VASCULAR AND LYMPHATIC SUPPLY OF THE URETER	35
THE BLADDER	36
MUSCULATURE OF THE BLADDER	37
RELATION AND FIXATION OF THE BLADDER	39
VASCULAR AND LYMPHATIC SUPPLY OF THE BLADDER	40
INNERVATION OF THE BLADDER AND LOWER URETHRA	41
THE URETHRA	42
DIVISION	42
PELVIC AND URETHRAL FASCIA AND MUSCLES	43
THE PENIS	44
THE PREPUCE	44
THE SCROTUM	45

	PAGE
CHAPTER	53
THE TESTES	54
CILIA	55
BLOOD AND LYMPHATIC SUPPLY	56
THE EPIDIDYMI	57
THE VAS DEFERENS	61
3 PHYSIOLOGY	61
URINARY TRACT	61
KIDNEY	62
PHYSIOLOGY OF THE NERVES OF THE KIDNEY	63
THE URINE	63
THE RENAL PELVIS	64
THE URETER	64
THE BLADDER	64
PHYSIOLOGY OF MICTURITION	66
THE URETHRA	66
GENITAL TRACT	66
THE SCROTUM	66
THE TESTICLES	67
VASA EFFERENTIA	67
THE EPIDIDYMI	68
THE VAS DEFERENS	69
SEMINAL VESICLES	69
THE PROSTATE GLAND	70
THE VERUMONTANUM	70
GLANDS	70
THE PENIS	71
THE SEMEN	71
THE SPERMATOZOA	71
4 UROLOGIC INSTRUMENTS	72
SCALES	72
URETHRAL INSTRUMENTS	73
CATHETERS	73
URETHRAL BOUGIES	77
URETHRAL SOUNDS	78
URETERAL INSTRUMENTS	80
URETERAL CATHETERS	80
SYRINGES	81
IRRIGATORS (PERCOLATORS)	83
FORMALIN STERILIZERS AND CABINETS	84
5 MINOR OFFICE TECHNIC	85
ROUTINE OFFICE EXAMINATION	85
INTERNAL	85
EXAMINATION OF THE GENITALIA	85
TAKING THE SMEAR	85
INTERNAL	87
RECTAL EXAMINATION	87
PALPATION OF THE PROSTATE	88
PALPATION OF SEMINAL VESICLES	89
MASSAGE OF THE PROSTATE	89
MASSAGE OF THE CONTENTS OF THE SEMINAL VESICLES	89
MASSAGE OF COWPER'S GLANDS	89
BIMANUAL PALPATION OF THE VESICLES	90
TREATMENT	90
PASSAGE OF A SOUND	90

CHAPTER	PAGE
PASSAGE OF A CATHETER	92
INSTILLATION, IRRIGATION AND INJECTION	96
 6 URETHROSCOPY, CYSTOSCOPY AND URETERAL CATHETERIZATION	100
URETHROSCOPY	100
CYSTOSCOPY	103
TECHNIC OF CYSTOSCOPY (OR OF URETHROCYSTOSCOPY)	106
URETERAL CATHETERIZATION	110
 7 RADIOGRAPHY OF THE UROGENITAL TRACT	114
DIAGNOSTIC METHODS	114
SIMPLE RADIOGRAPHY	114
RADIOGRAPHY WITH THE AID OF OPAQUE URETERAL CATHETERS	116
ASCENDING OR RETROGRADE UROGRAPHY	118
EXCRETORY OR DESCENDING UROGRAPHY	120
CYSTOGRAPHY	126
URETHROGRAPHY	130
SEMINAL VESICULOGRAPHY AND RADIOGRAPHY OF THE EPIDIDYMIS	131
8 LABORATORY METHODS	134
THE URINE	134
1. CHEMICAL MICROSCOPIC AND PHYSICAL PROPERTIES	134
A. ORDINARY (CHEMICAL AND MICROSCOPIC)	134
B. EPITHELIAL, RED-BLOOD-CELL AND LEUKOCYTE CONTENT	135
1. EPITHELIAL CELLS	135
2. RED-BLOOD-CELLS	135
3. LEUKOCYTES	135
C. REACTION OF THE URINE	136
DETERMINATION OF HYDROGEN ION CONCENTRATION	136
2. BACTERIOLOGIC EXAMINATION OF THE URINE	137
EXAMINATION OF STAINED SMEARS OF THE CENTRIFUGED SEDIMENT	137
INOCULATION OF CENTRIFUGED URINARY SEDIMENT ON CULTURE MEDIUMS	138
INOCULATION OF LABORATORY ANIMALS WITH THE CENTRIFUGED URINARY SEDIMENT	138
PITFALLS IN THE INTERPRETATION OF SMEARS AND CULTURES	139
RENAL FUNCTION TESTS	139
1. BIOCHEMICAL EXAMINATION OF THE BLOOD	139
2. TOTAL RENAL FUNCTION TESTS	140
THE PHENOLSULPHONETHYLSULFONATE TEST	140
OTHER TOTAL FUNCTION TESTS	143
3. SEPARATE FUNCTION TESTS	144
THE INDIGO-CARMINE TEST	144
THE PITHALEIN TEST	145
9 ANESTHESIA IN UROLOGY	147
METHODS	147
GENERAL INTALATION ANESTHESIA	148
SURFACE (MUCOUS MEMBRANE) ANESTHESIA	149
INFILTRATION ANESTHESIA AND NERVE BLOCKING	149
REGIONAL ANESTHESIA	151
SPINAL ANESTHESIA	152
INTRAVENOUS ANESTHESIA	154
10 TERMINOLOGY AND UROLOGIC STUDY	155
DISTURBANCE OF URINATION TERMS	155
CHANGES IN URINARY OUTPUT AND COMPOSITION OF URINE	155
MISCELLANEOUS TERMS	156

	PAGE
CHAPTER	156
TAKING A UROLOGIC HISTORY	160
LOCAL UROLOGIC STUDY (OR EXAMINATION)	160
CHIEF CLINICAL DATA	

PART TWO

GONORRHEA VENEREAL ULCERS

11 GONORRHEA	169
GENERAL CONSIDERATIONS	169
ETIOLOGY	170
IMMUNITY	170
REINFECTION AND RECURRENCES	171
EXCITING CAUSE	171
PATHOLOGY OF GONORRHEA	172
PATHOLOGY OF ACUTE URETHRITIS	173
PATHOLOGY OF CHRONIC GONORRHEAL URETHRITIS	174
SYMPTOMS OF ACUTE GONORRHEA	175
LOCAL SYMPTOMS	175
GENERAL SYMPTOMS	176
TYPES OF GONORRHEA	176
HYPERACUTE TYPE OF ACUTE GONORRHEA	176
SUBACUTE TYPE OF ACUTE GONORRHEA	177
SUBACUTE GONORRHEA	177
COMPLICATIONS OF ACUTE GONORRHEA	177
POSTERIOR URETHRITIS	177
PROSTATITIS	179
1 ACUTE CATARRHAL PROSTATITIS	179
2 ACUTE FOLLICULAR PROSTATITIS	179
3 ACUTE PARENCHYMATOUS PROSTATITIS	179
PROSTATIC ABSCESS DUE TO ACUTE GONORRHEA	180
SEMINAL VESICULITIS	180
EPIDIDYMITIS	181
PERIURETHRITIS AND PERIURETHRAL ABSCESS	183
EDEMA	184
LYMPHANGITIS	184
GONORRHEAL PYELITIS	185
ESSENTIAL FEATURES OF DIAGNOSIS OF GONORRHEA	185
DIFFERENTIAL DIAGNOSIS OF COMPLICATIONS OF ACUTE GONORRHEA	185
SUBACUTE GONORRHEA	187
CHRONIC GONORRHEA	187
CHRONIC PROSTATOVESICULITIS	188
RECURRENCES IN GONORRHEA	189
CHRONIC ANTERIOR URETHRITIS	190
URINE IN GONORRHEA	191
PHYSICAL CHARACTERISTICS TESTS	191
PROGNOSIS OF GONORRHEA	194
PROPHYLAXIS OF GONORRHEA	195
SYSTEMIC AND EXTRACENTRAL GONOCOCCAL INFECTION	195
SYSTEMIC INFECTION	195
EXTRAGENTIAL GONORRHEAL INFECTION	198
12 TREATMENT OF GONORRHEA	201
GENERAL PRINCIPLES	201
PERSONAL AND SEXUAL HYGIENE	202

CHAPTER	PAGE
INTERNAL MEDICATION	204
LOCAL TREATMENT	205
INJECTIONS	206
IRRIGATIONS	206
INSTILLATIONS	207
ROUTINE TREATMENT	207
ACUTE GONORRHEA	207
HYPERACUTE GONORRHEA	210
SUBACUTE TYPE	210
ACUTE POSTERIOR URETHRITIS	210
FOLLICULAR PROSTATITIS WITH VESICULITIS IN ACUTE GONORRHEA	210
PROSTATIC ABSCESS	211
PYOVESICULOSIS	212
EPIDIDYMITIS	212
LOCAL COMPLICATIONS OF GONORRHEA	213
GONORRHEAL ARTHRITIS	213
FOCAL	213
LOCAL	214
SYSTEMIC	214
TREATMENT OF SUBACUTE GONORRHEA	214
CHRONIC GONORRHEA	214
CHRONIC ANTERIOR URETHRITIS	215
DETERMINATION OF THE CURE OF GONORRHEA IN THE MALE	216
A ACUTE GONORRHEA	216
B CHRONIC GONORRHEA	217
13 STRicture OF THE URETHRA	219
TYPES OF STRICTURE	220
PATHOLOGY OF STRICTURE	222
LOCATION OF STRICTURE	224
SYMPTOMS OF STRICTURE	224
COMPLICATIONS OF STRICTURE	226
CLINICAL COURSE OF URETHRAL STRICTURE	227
DIAGNOSIS OF STRICTURE	227
BY INSTRUMENTAL EXAMINATION	227
BY MEANS OF CLINICAL FINDINGS	228
PROGNOSIS	229
TREATMENT OF STRICTURE	229
GENERAL CONSIDERATIONS	229
INSTRUMENTS	230
THE DILATATION OF A STRICTURE	230
TREATMENT OF ACUTE URINARY RETENTION DUE TO STRICTURE	232
COMPLICATIONS	233
URINARY EXTRAVASATION	233
CHRONIC URINARY EXTRAVASATION	237
14 GONORRHEA IN THE FEMALE	238
ACUTE GONORRHEA	238
CHRONIC GONORRHEA	241
COMPLICATIONS	242
SEQUELAE	243
DIAGNOSIS	243
PROGNOSIS	244
TREATMENT	244
FEVER THERAPY	244
CHEMOTHERAPY	245
COMBINED METHOD	246

CHAPTER	PAGE
15 CHANCER AND EARLY SYPHILIS	248
GENERAL CONSIDERATIONS	248
THE GENITAL CHANCER	250
CLASSIFICATION	251
EXTRAGENITAL CHANCERS	251
THE CLINICAL CHARACTERISTICS OF THE CHANCER	252
THE CLINICAL COURSE OF THE CHANCER	252
DIAGNOSIS OF THE CHANCER	252
DARK FIELD EXAMINATION FOR SPIROCHETES	253
LOCATION OF THE CHANCER	255
DIFFERENTIAL DIAGNOSIS	255
TREATMENT	258
FIVE COURSES	258
U. S. PUBLIC HEALTH SERVICE TREATMENT	259
16 CHANCROID, LYMPHOGRAPHIA VENEREUM AND OTHER VENEREAL ULCERATIONS	260
CHANCROID	260
TYPES OF LESIONS	262
COMPLICATIONS OF CHANCROIDS	262
DIAGNOSIS OF CHANCROID	264
PROGNOSIS	264
TREATMENT	264
GRANULOMA INGUINALE	265
LYMPHOGRAPHIA VENEREUM	267
THE FIRST TEST	268
OTHER VENEREAL ULCERATIONS	269

PART THREE

MALE GENITALIA

17 PENIS AND URETHRA	275
ANOMALIES AND MALFORMATIONS	275
ANOMALIES OF THE PENIS	275
ANOMALIES OF THE PREPUCE	276
ANOMALIES OF THE URETHRA	276
INJURIES OF THE PENIS AND URETHRA	281
INJURIES OF THE PENIS	281
INJURIES OF THE URETHRA	282
FISTULA, FOREIGN BODIES AND CALCULI OF THE URETHRA	286
DISEASES	288
DISEASES OF THE PENIS	288
CUTANEOUS AFFECTIONS	288
INFLAMMATION	288
LYMPHANGITIS	289
EDEMA	291
GANCROUS	292
INDURATION	292
BENIGN TUMOR	292
CARCINOMA	293
SARCOMA	293
DISEASES OF THE URETHRA	295
CARCINOMA OF THE MALE URETHRA	295
SARCOMA OF THE MALE URETHRA	297
HYPERMORPHOSIS	298
	298

PAGE	PAGE
18 THE PROSTATE	301
ANOMALIES	301
INJURIES OF THE PROSTATE	301
PROSTATIC CALCULI	302
INFECTIONS OF THE PROSTATE	304
ACUTE PROSTATITIS	304
CHRONIC PROSTATITIS	305
TUBERCULOSIS OF THE PROSTATE	307
SYPHILIS OF THE PROSTATE	308
HYPERTROPHY OF THE PROSTATE AND OTHER BLADDER NECK OBSTRUCTIONS	308
PATHOLOGY OF OBSTRUCTIVE LESIONS	309
EFFECTS OF OBSTRUCTION	319
CLINICAL PICTURES	322
DIAGNOSIS	325
TREATMENT	332
MALIGNANCIES OF THE PROSTATE	343
CARCINOMA OF THE PROSTATE	343
SARCOMA AND OTHER RETROVESICAL NEOPLASMS	353
19 THE SEMINAL VESICLES	354
ANATOMY ANOMALIES INJURIES CALCULI AND TUMORS	355
INFECTIONS	357
TUBERCULOSIS	357
PUSS TUBES IN THE MALE (BELLFIELD)	357
MODE OF INFECTION	357
PATHOLOGY	358
SYMPTOMS	361
DIAGNOSIS	367
TREATMENT	369
20 THE DEFERENS SPERMATIC CORD AND EPIDIDYMI	373
VAS DEFERENS	373
INFECTIONS	373
STRICTURES	375
SPERMATIC CORD	376
INJURIES	376
TORSION	376
TUMORS	378
EPIDIDYMI	380
ANOMALIES CALCULI, INJURY AND TUMORS	380
INFECTIONS	382
TUBERCULOSIS OF THE MALE GENITALIA	389
TUBERCULOSIS OF THE EPIDIDYMI	391
TUBERCULOSIS OF THE SEMINAL VESICLES	397
TUBERCULOSIS OF THE PROSTATE	399
21 TESTIS AND SCROTUM	402
ANOMALIES OF THE TESTIS	402
ANOMALIES IN SIZE	402
ANOMALIES IN POSITION	402
TREATMENT IN CRYPTORCHIDISM	409
INJURY OF THE TESTIS	411
ATROPHY OF THE TESTIS	411
INFECTIONS OF THE TESTIS ORCHITIS	412
HYDROCELE AND HEMATOCELE	414
HYDROCELE	414
HEMATOCELE	420
CHYSTICEL	420

CHAPTER	PAGE
NEOPLASMS OF THE TESTIS	420
PATHOLOGY	420
SYMPTOMS AND DIAGNOSIS	423
TREATMENT	424
THE SCROTUM	424
22 STERILITY IN THE MALE	428
REQUISITES FOR FERTILITY	428
STUDY OF THE MALE	429
CAUSES OF STERILITY	429
RÉSUMÉ OF PHYSIOLOGY AND PATHOLOGY	430
ACCESSORY SEX GLANDS	431
THE SEMEN AND SPERMATOZOA	431
SEMEN	432
SPERMATOZOA	432
EXAMINATION OF SEMEN	438
FERTILITY AND INFERTILITY	438
DEFFECTIVE PRODUCTION OF SPERMATOZOA	439
HOSTILITY IN THE SEMINAL DUCT	440
FAULTS OF DELIVERY	441
TREATMENT	441
STERILIZATION IN THE MALE	442
23 SEX NEUROSES	443
MASTURBATION	443
POLLUTIONS	444
IMPOTENCE	444
ORGANIC CAUSES	444
FUNCTIONAL CAUSES	445
PSYCHIC CAUSES	446
PSYCHOPATHIA SEXUALIS	446
PATHOLOGIC ERECTIONS	446

PART FOUR

BLADDER

24 ANOMALIES AND INJURIES OF THE BLADDER	451
ANOMALIES	451
COMPLETE ABSENCE (APLASIA)	451
DOUBLE BLADDER	451
EXSTROPHY (ECTOPIA VESICAL)	451
AFFECTIONS OF THE URACHUS	454
INJURIES OF THE BLADDER	455
WOUNDS	455
RUPTURES	457
SPONTANEOUS RUPTURE	461
25 CYSTITIS AND PERICYSTITIS	462
CYSTITIS	462
ACUTE CYSTITIS	463
CHRONIC CYSTITIS	467
WITH PREDOMINANT INVOLVEMENT OF THE MUCOSA	468
WITH PREDOMINANT INVOLVEMENT OF THE SUBMUCOUS AND MUSCULAR COATS	471
SYMPTOMS	472
DIAGNOSIS	473
TREATMENT	474

CONTENTS

xiii

CHAPTER	PAGE
CHRONIC TRIGONAL CYSTITIS	475
SYPHILIS OF BLADDER	476
BILHARZIOSIS	476
ECHINOCOCCUS	476
PERICYSTITIS	477
BLADDER FISTULAE	478
26 BLADDER DIVERTICULA, HERNIAE CALCULI, AND FOREIGN BODIES	480
DIVERTICULAE	480
DEFINITIONS, FORMS AND SIZE	480
VIEWS AS TO MODE OF ORIGIN	481
COMPLICATIONS	484
SYMPTOMS	487
DIAGNOSIS	487
TREATMENT	489
HERNIA OF THE BLADDER	490
CALCULI	492
THEORIES OF FORMATION	492
INCIDENCE SIZE AND LOCATION	495
VARIETIES	496
COMPLICATIONS	497
SYMPTOMS	497
DIAGNOSIS	498
TREATMENT	500
FOREIGN BODIES	502
27 TUMORS OF THE BLADDER	504
PREDISPOSING FACTORS	504
CLASSIFICATION OF BLADDER TUMORS	506
PRIMARY BLADDER TUMORS	506
DESCRIPTION OF PRIMARY TUMORS	506
SECONDARY BLADDER TUMORS	510
RETROVERICAL TUMORS	511
HOW BLADDER TUMORS SPREAD AND ENDANGER LIFE	511
SYMPTOMS	512
DIAGNOSIS	513
TREATMENT	516
METHODS	517
SUMMARY OF METHODS OF TREATMENT	518
28 NEUROGENIC DYSFUNCTION OF THE BLADDER	519
ANATOMY AND PHYSIOLOGY	519
SYMPTOMATOLOGY	519
DIAGNOSIS	522
TREATMENT	530
ELECTRICAL STIMULATION	530
CONTINUOUS BLADDER IRRIGATION	531
DRUGS	531
SURGERY	532

PART FIVE

URETER

29 ANOMALIES OF THE URETER	535
ANOMALIES OF CALIBER AND FORM	535
CONGENITAL STRICTURE	535

CHAPTER	PAGE
CONGENITAL VALVES OR FOLDS	537
CONGENITAL DILATATION WITHOUT DEMONSTRABLE OBSTRUCTION	537
CONGENITAL DIVERTICULA	538
SPIRAL TWISTS (TORSION)	539
KINKS	539
POST-CAVAL URETERS	540
ANOMALIES OF ORIGIN AND TERMINATION	541
ANOMALIES OF ORIGIN	541
BLIND-ENDING URETERS	543
ECTOPIC ENDING	545
URETEROCELE	548
30 INJURIES, STRICTURES AND OTHER INFLECTIONS OF THE URETER	552
INJURIES OF THE URETER	552
A NONPENETRATING OR PENETRATING FORCE	553
GYNECOLOGIC OPERATIONS	553
PENETRATION OF THE URETHRA BY INSTRUMENTS	555
STRICTURE OF THE URETER	556
PRELIMINARY CONSIDERATIONS	556
NORMAL LEVELS OF NARROWING	556
MUSCLE SPASM	556
DEFINITION	556
CLASSIFICATION ACCORDING TO ETIOLOGY	556
INCIDENCE, LOCATION, AGE AND SEX	558
CLINICAL PICTURES	560
DIAGNOSIS	560
TREATMENT	562
INFECTION OF THE URETER	563
31 URETERAL CALCULI AND NEOPLASMS	566
URETERAL CALCULI	566
GENERAL CONSIDERATIONS	566
COMPLICATIONS	568
CLINICAL PICTURES	571
DIAGNOSIS	572
TREATMENT	577
URETERAL NEOPLASMS	582
ORIGIN	582
LOCATION, AGE AND INCIDENCE	584
SYMPTOMS	584
EXAMINATION	584
DIAGNOSIS	585
TREATMENT	586

PART SIX

KIDNEY

32 ANOMALIES OF THE KIDNEY	589
CLASSIFICATION	589
ANOMALIES OF NUMBER	590
SOLITARY KIDNEY	590
SUPERNUMERARY KIDNEY	595
ANOMALIES OF VOLUME	595
HYPOPLASIA	595
SUPPLEMENTARY LOBE OR HYPERTROPHY	599

CONTENTS

xv

CHAPTER	PAGE
ANOMALIES OF FORM	599
ANOMALIES OF LOCATION	599
ORDINARY OR SIMPLE ECTOPIA	599
BILATERAL CONGENITAL ECTOPIA	601
CROSSED ECTOPIA	603
MIDLINE FUSION	607
HORSESHOE KIDNEY INCLUDING L-SHAPED KIDNEY	607
CAKE KIDNEY AND SIGMOID KIDNEY	609
ANOMALIES OF ROTATION	616
REDUPLICATION OF THE PELVIES AND URETERS	617
ANOMALIES OF THE RENAL PELVIS OTHER THAN DOUBLE KIDNEY	623
ANOMALIES OF THE VESSELS	624
UNCLASSIFIED ANOMALIES OF THE KIDNEY AND URETERS	624
ACCOMPANYING (CONCOMITANT) ANOMALIES	624
33 INJURIES OF THE KIDNEY	626
SUBCAPSULAR INJURIES	626
MECHANISM	626
CHANGES IN AND AROUND THE KIDNEY	627
COMPLICATIONS AND SEQUELAE	630
CLINICAL PICTURES	632
DIAGNOSIS	635
TREATMENT	637
EXTERNAL (PENETRATING) WOUNDS	639
CLINICAL PICTURES AND DIAGNOSIS	639
TREATMENT	640
SPONTANEOUS RUPTURE OF THE KIDNEY	640
34 ANOMALIES ANEURISMS AND THROMBOSIS OF THE MAIN RENAL VESSELS	641
ANOMALIES	641
ANEURISM OF THE MAIN RENAL ARTERY OR ITS BRANCHES	647
ETIOLOGY	647
TREATMENT	648
PERIRENAL HEMATOMA	648
INCIDENCE AND ETIOLOGY	649
CLINICAL PICTURES	650
DIAGNOSIS	650
TREATMENT	651
INFARCTION OF THE KIDNEY	651
SITE	651
INCIDENCE	651
ETIOLOGY	652
EFFECTS ON KIDNEY	652
SYMPTOMS AND DIAGNOSIS	652
TREATMENT	653
35 MOVABLE KIDNEY (DROPPED KIDNEY)	654
NORMAL KIDNEY	654
MOVABLE KIDNEY	655
INCIDENCE SEX AGE AND SITE	655
ETIOLOGY	655
MECHANISM OF MIGRATION	656
PATHOLOGY	656
CLINICAL PICTURES	658
DIAGNOSIS	659
TREATMENT	659

CHAPTER	PAGE
36 HYDRONEPHROSIS	662
DEFINITION	662
ETIOLOGY	662
MECHANICAL CAUSES	662
ADYNAMIC CAUSES	664
DUE TO NEUROGENIC DYSFUNCTION	664
PATHOLOGY	664
LOCATION OF THE ECTASIS	664
COMPLICATIONS	665
SYMPTOMS	667
DIAGNOSIS	668
TREATMENT	670
37 SOLITARY RENAL CYSTS AND POLYCYSTIC KIDNEYS	672
TYPES	672
MINUTE	672
SOLITARY	674
PARAPELVIC	674
POLYCYSTIC	675
38 SYPHILIS, ACTINOMYCOSIS AND ECHINOCOCCUS OF THE KIDNEY	682
SYPHILIS	682
SYMPTOMS, DIAGNOSIS AND TREATMENT	682
ACTINOMYCOSIS	683
INCIDENCE AND PATHOLOGIC CHANGES IN THE KIDNEY	683
SYMPTOMS AND DIAGNOSIS	683
TREATMENT	684
NON-ACTINOMYCOTIC INFECTIONS	685
ECHINOCOCCUS OF THE KIDNEY	685
LOCATION, AGE AND COMPLICATIONS	685
SYMPTOMS AND DIAGNOSIS	686
TREATMENT	687
39 NONTUBERCULOUS INFECTIONS OF THE KIDNEY	688
BACTERIOLOGY	688
ROUTE OF INFECTION	690
PATHOLOGY	694
ACUTE CHANGES IN PYELONEPHRITIS	694
CHRONIC PYELONEPHRITIS	696
CLINICAL PICTURES AND DIAGNOSIS	700
ACUTE CASES WITHOUT AND WITH LOCALIZING SIGNS	701
CHRONIC CASES WITHOUT AND WITH LOCALIZING SIGNS	702
TREATMENT OF HYPERACUTE AND ACUTE PYELONEPHRITIS	706
TREATMENT OF CHRONIC PYELONEPHRITIS	708
40 PERI- AND PARARENAL INJECTIONS (NONTUBERCULOUS)	715
MODES OF INVASION OF THE PERINEPHRIC FATTY CAPSULE	715
ANATOMIC CONSIDERATIONS	716
LOCATIONS OF PERI- AND PARANEPHRITIC ABSCESS	718
BACTERIOLOGY, AGE AND SEX	719
CLINICAL PICTURES	719
ACUTE PERINEPHRITIC ABSCESS	719
DIAGNOSIS	720
TREATMENT OF PERINEPHRITIC ABSCESS	722
FIBROSCLEROTIC OR FIBROLIPOMATOUS PERINEPHRITIS	723

CONTENTS

xvii

CHAPTER	PAGE
41 TUBERCULOSIS OF THE URINARY TRACT	724
GENERAL CONSIDERATIONS	724
INCIDENCE AGE, SEX, SIDE	724
PATHOGENESIS	725
ROUTE OF INFECTION	725
ASSOCIATION OF RENAL AND GENITAL TUBERCULOSIS	726
TYPES OF TUBERCLE BACILLI IN UROGENITAL INFECTIONS	726
PATHOLOGIC CHANGES	726
ACUTE AND SUBACUTE	727
MILIARY FORMS	727
CHRONIC FORMS	727
CHANGES IN OTHER PORTIONS OF THE URINARY TRACT	731
CLINICAL PICTURES	731
CLINICAL PICTURES IN RENAL TUBERCULOSIS	731
DIAGNOSIS	734
ANALYSIS OF THE CLINICAL HISTORY	734
EXAMINATION FOR EXTRARENAL TUBERCULOSIS	735
UROLOGIC STUDY OR EXAMINATION	735
TREATMENT OF RENAL TUBERCULOSIS	742
NONOPERATIVE TREATMENT	742
OPERATIVE TREATMENT BY NEPHRECTOMY	744
POSTOPERATIVE COMPLICATION	744
BILATERAL CASES OF RENAL TUBERCULOSIS	745
42. NEPHROLITHIASIS	746
INCIDENCE	746
PHYSICAL CHARACTERISTICS	746
COMMON TYPES	746
RARE TYPES	747
CHEMICAL CHARACTERISTICS	748
ANALYSIS OF RENAL CALCULI	748
SITE	749
COMPLICATIONS OF NEPHROLITHIASIS	751
INTRARENAL COMPLICATIONS	751
SPONTANEOUS RUPTURE	752
SYMPTOMS	754
CLINICAL PICTURES	754
DIAGNOSIS	756
PATIENT'S HISTORY	756
EXAMINATION	757
GENERAL EXAMINATION	757
UROLOGIC EXAMINATION	757
TREATMENT	763
PAIN	763
ACUTE PYELONEPHRITIS SYNDROME	764
CALCULOUS ANURIA	764
PATIENT SEEN DURING A QUIESCENT PERIOD	765
NONOPERATIVE TREATMENT	765
INDICATIONS FOR OPERATIVE INTERVENTION	766
RECURRENCE AFTER OPERATION	770
FALSE RECURRENCE	771
TRUE RECURRENCE	771
43 NEOPLASMS OF THE KIDNEY AND ADJACENT STRUCTURES	774
NEOPLASMS OF THE KIDNEY PARENCHYMA	774
BENIGN NEOPLASMS OF THE PARENCHYMA	774

CHAPTER	PAGE
MALIGNANT NEOPLASMS OF THE PARENCHYMA	776
CARCINOMA	777
SARCOMA	777
EMBRYONAL ADENOSARCOMA	777
NEOPLASMS OF THE RENAL PELVIS	778
PAPILLOMA	778
SQUAMOUS-CELL CARCINOMA	779
MULTIPLE NEOPLASMS	779
COINCIDENT NEOPLASMS	779
BILATERAL RENAL NEOPLASMS	780
LOCAL AND SYSTEMATIC METASTASIS	780
CLINICAL PICTURES	781
HEMATURIA	782
TUMOR	783
PAIN	783
FEVER	784
DIAGNOSIS	784
CLINICAL HISTORY	784
UROLOGIC STUDY	788
TREATMENT	792
NEPHRECTOMY	792
PRE-OPERATIVE IRRADIATION OF MALIGNANT RENAL NEOPLASMS	794
PERIRENAL AND OTHER RETROPERITONEAL NEOPLASMS	794
NEOPLASMS OF THE FIBROUS AND FATTY CAPSULES	794
UNATTACHED TUMORS OF EMBRYONAL UROCENTAL APPARATUS	795
OTHER RETROPERITONEAL NEOPLASMS	795
NEOPLASMS OF THE ADRENAL	797
44 NEPHRITIS	801
INCIDENCE	801
CLASSIFICATION	801
ALBUMINURIA	802
UREMIA	803
KIDNEY OF TOXEMIA OF PREGNANCY	803
FOCAL GLOMERULONEPHRITIS	804
TOXIC NEPHRITIS OR NEPHROSIS	804
ACUTE DIFFUSE GLOMERULO NEPHRITIS	804
SUBACUTE NEPHRITIS WITH EDEMA	806
CHRONIC NEPHRITIS WITH EDEMA	807
CHRONIC NEPHRITIS WITHOUT EDEMA	809
RENAL RICKETS	810
ARTERIOSCLEROTIC BRIGHT'S DISEASE	810
SURGERY OF NEPHRITIS	811

PART SEVEN

UROLOGY IN THE FEMALE AND IN CHILDREN

45 UROLOGY IN THE FEMALE	815
THE FEMALE URETHRA	815
ANATOMY	815
ABNORMALITIES	816
DIVERTICULA	818
PROLAPSE	819
ACQUIRED STRICTURES	820
BENIGN NEOPLASMS	821

CHAPTER	PAGE
MALIGNANT NEOPLASMS	822
CARCINOMA	822
INFECTIONS OF URETHRA AND BLADDER	824
SPECIFIC AND NONSPECIFIC URITRITIS	824
NONSPECIFIC INFECTIONS OF THE FEMALE URETHRA AND BLADDER	824
MODES OF INFECTION	824
PREDISPOSING CAUSES	824
PATHOLOGIC CHANGES	825
SYMPTOMS	826
DIAGNOSIS	827
TREATMENT	828
TRICHOMONAS VAGINALIS INFECTIONS OF THE LOWER URINARY TRACT	829
INCONTINENCE OF URINE IN THE FEMALE	830
VESICAL CAUSES	830
EXTRAUTERINE CAUSES	830
SYMPTOMS	831
TREATMENT	831
UROGENITAL FISTULAE	834
UROLOGIC COMPLICATIONS OF GENITAL ORIGIN	838
CANCER OF THE CERVIX	838
IRRADIATION OF THE UTERUS	839
RENAL INFECTION IN PREGNANCY AND THE PUERPERIUM	840
FEMALE PSEUDOHERMAPHRODISM	844
46 UROLOGY IN CHILDREN	846
METHODS OF UROLOGIC EXAMINATION	846
LOWER URINARY TRACT OBSTRUCTION	848
THE ROLE OF ANOMALIES	848
EFFECTS OF LOWER TRACT OBSTRUCTION	850
CLINICAL PICTURES	851
DIAGNOSIS	852
TREATMENT	852
UPPER URINARY TRACT OBSTRUCTION	853
THE ROLE OF ANOMALIES	853
CLINICAL PICTURES	854
DIAGNOSIS AND TREATMENT	854
SMOOTH MUSCULAR DYSFUNCTIONS OF THE URINARY TRACT	854
PATHOLOGIC AND CLINICAL PICTURE	855
ETIOLOGY	855
RENAL INFECTION IN CHILDREN	856
PREDISPOSING CAUSES	856
CLINICAL PICTURES	856
DIAGNOSIS	856
TREATMENT	857
TUBERCULOSIS	859
UROGENITAL	859
URETER, BLADDER AND URETHRA, MALE GENITALIA	861
UROLITHIASIS	861
NEOPLASMS OF THE UROGENITAL TRACT	862
KIDNEY	862
BLADDER	863
PENIS AND URETHRA	863
TESTIS	863
PROSTATE	864
ADRENAL	864
GONORRHEA IN CHILDREN	864

CHAPTER	PAGE
Boys	864
Girls	865
ENURESIS	869

PART EIGHT

PATHOLOGIC CHANGES IN OUTPUT AND
COMPOSITION OF THE URINE

47 ANURIA, HEMATURIA, PYURIA, CHYLURIA	875
PATHOLOGIC CHANGES IN URINARY OUTPUT AND COMPOSITION	875
ANURIA	877
HEMATURIA	877
SYSTEMIC CAUSES	880
DUE TO LESIONS OF ADJACENT STRUCTURES	881
DUE TO LESIONS OF THE GENITO-URINARY TRACT	882
PYURIA	885
SOURCES	886
CHYLURIA	888
PHOSPHATURIA	891
OVALURIA	891
URATURIA	892

PART NINE

OPERATIVE TECHNIC

48 OPERATIONS ON THE PENIS AND URETHRA	895
DORSAL SLIT	895
CIRCUMCISION	896
MEATOLOMY	899
URETHROTOMY	900
AMPUTATION OF THE PENIS	904
RADICAL OPERATION FOR CARCINOMA OF THE PENIS	905
HYPOSPADIOS	905
EPISPADIAS	907
49 OPERATIONS ON THE PROSTATE AND SEMINAL VESICLES	908
PROSTATECTOMY	908
YOUNG TECHNIC OF PERINEAL PROSTATECTOMY	908
SUPRAPUBIC PROSTATECTOMY	913
LATE COMPLICATIONS OF PROSTATECTOMY	920
OPERATIONS FOR CARCINOMA OF THE PROSTATE	921
OPERATIONS ON THE TRIGONE	921
TRANSURETHRAL RESECTION OF THE PROSTATE AND OTHER BLADDER NECK OBSTRUCTIONS	922
PROSTATOMY	926
OPERATIONS ON THE SEMINAL VESICLES	926
VESICULECTOMY	926
50 OPERATIONS ON THE SCROTUM AND ITS CONTENTS	928
OPERATIONS ON THE VAS DEFERENS	928
OPERATIONS FOR HYDROCELE	930
OPERATION FOR VARICOCELE	932
ORCHIDOPEXY	932

CHAPTER	PAGE
OPERATIONS ON THE EPIDIDYMS	939
ORCHIDECTOMY	941
51 OPERATIONS FOR STERILITY IN THE MALE	943
STRICTURES	943
EJACULATORY DUCTS	943
VAS DEFERENS	943
TREATMENT	944
VASO-EPIDIDYMOSTOMY	944
UNION OF VAS DEFERENS TO SPERMATOCELF	946
UNION OF VAS DEFERENS TO THE RETE TESTIS	946
52 OPERATIONS ON THE BLADDER	948
OPERATIONS ON THE BLADDER	948
SUPRAPUBIC CYSTOTOMY	948
DIVERTICULECTOMY	952
RESECTION OF THE BLADDER	954
TOTAL CYSTECTOMY FOR CANCER	957
53 OPERATIONS ON THE KIDNEY AND URETER	967
SURGICAL ANATOMY OF OPERATIONS ON THE KIDNEY AND UPPER URETER	967
TOPOGRAPHY OF THE ILIOCASTAL SPACE	967
BLOOD VESSELS AND NERVES OF THE ILIOCASTAL SPACE	969
RELATIONS OF THE KIDNEYS TO ADJACENT STRUCTURES	971
PERITONEAL REFLECTION	973
OPERATIONS ON THE KIDNEY	973
GENERAL CONSIDERATIONS	973
PYELOTOMY	980
NEPHROLITHOTOMY	984
NEPHROSTOMY	985
NEPHROPEXY	986
RESECTION	988
HEMINEPHECTOMY	989
NEPHECTOMY	990
NEPHRO-URETERECTOMY	998
DENERVATION	999
PLASTIC OPERATION FOR HYDRONEPHROSIS	1001
ACCIDENTS DURING KIDNEY OPERATIONS	1006
OPERATIONS ON THE URETER	1008
SURGICAL ANATOMY OF THE URETER	1008
MOST FREQUENTLY EMPLOYED INCISIONS FOR URETERAL OPERATIONS	1011
GENERAL CONSIDERATIONS	1014
URETEROLITHOTOMY	1014
URETERECTOMY	1015
DIVERSION OF URINE FROM THE BLADDER	1015
NON INTESTINAL	1016
INTESTINAL	1016
54 POSTOPERATIVE COMPLICATIONS IN UROLOGY	1022
POSTOPERATIVE MORTALITY	1022
COMPLICATIONS WHICH MAY FOLLOW ANY ABDOMINAL OPERATION	1022
COMPLICATIONS ESPECIALLY APT TO OCCUR AFTER OPERATIONS ON THE URINARY TRACT	1030
PRE-OPERATIVE CAUTIONS	1031

PART ONE

STRUCTURE. FUNCTION NON-OPERATIVE TECHNIQS

CHAPTER	PAGE
1 EMBRYOLOGY	3
2 ANATOMY	16
3 PHYSIOLOGY	61
4 UROLOGIC INSTRUMENTS	72
5 MINOR OFFICE TECHNIC	85
6 URETHROSCOPY, CYSTOSCOPY AND URETERAL CATHETERIZATION	100
7 RADIOGRAPHY OF THE UROGENITAL TRACT	114
8 LABORATORY METHODS	134
9 ANESTHESIA IN UROLOGY	147
10 TERMINOLOGY AND UROLOGIC STUDY	155

ORIENTATION

A thorough knowledge of embryology, anatomy and physiology forms a solid foundation upon which to erect the superstructure of clinical medicine. Comparative embryology shows how the human kidney and ureter represent a higher stage of evolution of the primitive apparatus in invertebrates which has as its function, the elimination of the waste products of nitrogenous metabolism. The differentiation of the genital fold in the embryo into the male and female gonads and their excretory ducts can only be understood if the student is familiar with the embryology of vertebrates. The development of the external genitalia in both sexes bears an intimate relationship to a normal degree of function of certain glands of internal secretion, such as the pituitary and the adrenal. Attention is called to their dysfunction later in connection with pseudohermaphroditism.

The human kidney is an example of a remarkable adaptation of an organ to the necessity of excreting waste products of metabolism. Each kidney contains over 800,000 independent units, so that there is ample reserve power, even though a comparatively large portion of the parenchyma be temporarily or permanently unable to function. The variations in the blood supply of the kidney as well as the wide range in normal forms of its pelvis and calices are not only of anatomical but also of clinical interest as will be shown under Radiography. The most recent studies on the physiology of the kidney reveal the existence of both excretory and non-excretory functions. The glomerulus acts as a filter for all crystallized substances in the blood plasma whereas in the tubules, the original glomerular filtrate is changed into the definite urine. Marked progress has been made during the past ten years in the isolation of hormones of the testis and this knowledge has not only been applied in the treatment of prostatic hypertrophy but also in the diagnosis of tumors of the testis.

To attempt to practice in the special field of urology, without being familiar with the principal types of instruments and methods employed in both diagnosis and treatment, would be like asking a mechanic to construct an automobile, without having served an apprenticeship under someone who could call his attention to the tools, etc., which must be employed to construct such a complicated machine.

Our personal experience as teachers has impressed upon us the necessity of showing a student the various types of catheters, sounds, etc., and to point out the optical principles upon which cystoscopes are constructed. It is equally necessary to demonstrate how to examine and treat a patient by nonoperative methods, as described in Chapters 5 and 6. The present state of development of both radiographic and clinical laboratory technic has given rise to a demand for specialists in both of these fields. The student and practitioner cannot be expected to be able to be either a radiographer or a clinical laboratory technician, but at least they should be familiar with the interpretation of films and have a personally acquired working knowledge of the more important tests of renal function, staining methods for bacteria and the results of animal inoculation. With all of this background, the student is now ready to apply the principles of urology to its practice. The different methods of anesthesia and how to take the history of a urological case form the first story of the building for which the basic sciences and methods of diagnosis and treatment have constituted the solid foundation.

CHAPTER I

EMBRYOLOGY

DEVELOPMENT OF THE KIDNEY AND URETER
 COMPARATIVE EMBRYOLOGY
 DEVELOPMENT OF THE PERMANENT KIDNEY
 AND URETER IN MAN
 CHANGE IN POSITION OF THE KIDNEY DURING
 DEVELOPMENT
 DEVELOPMENT OF REPRODUCTIVE GLANDS AND THEIR
 DUCTS
 UNDIFFERENTIATED GLANDS
 DIFFERENTIATION INTO MALE AND FEMALE
 TYPES

THE GONADS
 DESCENT OF THE TESTIS
 DEVELOPMENT OF THE BLADDER
 DEVELOPMENT OF THE URETHRA AND ITS ACCESSORY
 GLANDS
 TRUE URETHRA
 UROGENITAL SINUS
 ACCESSORY GLANDS
 DEVELOPMENT OF THE EXTERNAL GENITALIA
 DEVELOPMENT OF SEMINAL VESICLES, EJACULATORY
 DUCTS AND VASA DEFERENTIA

DEVELOPMENT OF THE KIDNEY AND URETER

COMPARATIVE EMBRYOLOGY

A knowledge of the development of the excretory system in the lower vertebrates and to some extent in the invertebrates will greatly facilitate an understanding of the changes which take place in the human embryo especially in the formation of the permanent kidney (metanephros) and its excretory duct (the secondary or permanent ureter)

The simplest form of excretory system consists of one tubule termed nephridial for each segment (somite) of an embryo which either opens at the surface of the corresponding segment (as in the annelides) or the tubules empty at their distal ends into a common excretory duct (A of Fig 1) as in the vertebrates. Each such tubule is in intimate relation at its proximal end with a filtration apparatus for the passage of urea from the blood. In vertebrates there are two forms of filters. In one the tubule communicates with the coelum or body cavity (A of Fig 1) and corresponding to each opening or nephrostome, a branch of the aorta forms a network of capillaries which constitutes the filtration apparatus. In the second type each tubule (with or without communication with the coelum or body cavity) forms a malpighian body through invagination of its proximal end (B of Fig 1). A glomerular network of capillaries grows into this invaginated end and serves as a filtration apparatus.

In both of these rudimentary forms of excretory systems the urine reaches the cloaca by way of the primitive ureter. In Annelida, where there is no common excretory duct, there is a constant current of fluid which leads from the coelum or body cavity into the nephrostome (A of Fig 1) at the proximal end and is then carried to the distal end of the transverse tubule on the surface of each segment.

In higher vertebrates there are three excretory systems which differ both as to their origin and morphology. The first of these to appear is the pronephros which develops in the more cranially located segments. The next to appear is the mesonephros and the last one, the metanephros develops in the more caudally located segments.

The first two (pro and mesonephros) only exist during early fetal life in many of the mammalia and in the majority have no function as excretory organs.

Even in the lowest form of vertebrates where the pronephros attains its

highest degree of development, it seldom serves alone as an excretory organ, the work being shared by the mesonephros. The latter is less and less developed as one ascends in the scale of vertebrates so that in mammals the metanephros serves as the only excretory organ.

In man, there are two temporary urinary organs which correspond to the pro and mesonephros of the lower vertebrates and of the invertebrates. The

FIG 1

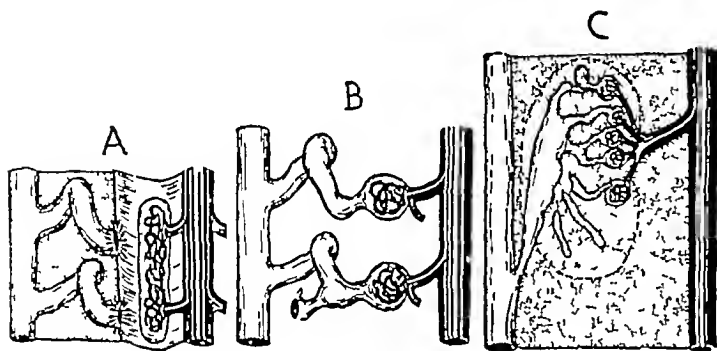


FIG 2

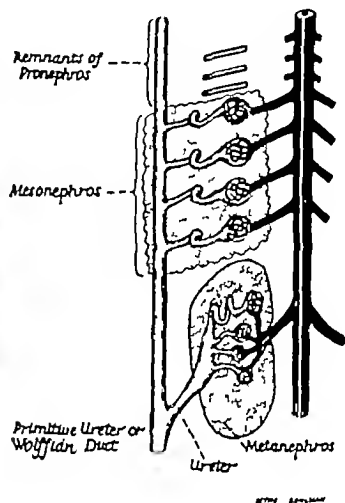


FIG 1—Comparative development of excretory apparatus (A) Simplest type seen in invertebrates. Broken down products of metabolism enter the body cavity through the capillary network and are taken up through the stomata as in (B), and carried either to the surface of the body, or as in A, to the common excretory duct.

B Slightly more developed form in which the capillary network invaginates the end of the proximal excretory duct and the water, salts, etc., are carried by means of a slightly convoluted tubule to the common excretory duct. In some of the lower animals there is a stoma which communicates with the body cavity in addition.

C More highly developed type of excretory apparatus as seen in man and higher vertebrates. Main branch of the renal artery breaks up into numerous branches and these into a capillary network or glomerulus which is surrounded by the proximal end of the primary excretory tubule forming the malpighian corpuscles. These tubules unite as shown in Fig 23 and empty into the renal pelvis.

FIG 2—Diagrammatic representation of simultaneous presence in the human embryo of the various types of excretory apparatus, as seen in the lower animals. Compare with Fig 1. Cephalad lie the remnants of the pronephros. A little more caudally lie the mesonephroi which in the male become portions of the epididymis. (See text.) The permanent kidney or metanephros lies still more caudal. Its primitive glomeruli being in contact with the collecting tubules through the medium of the convoluted tubules. The mode of formation of the renal pelvis and manner in which the ureter (permanent or secondary) empties into the primitive ureter or wolffian duct should be borne in mind. Compare with Fig 3.

pronephros never functions in the human embryo and there is much evidence according to Bromann¹ that although well differentiated histologically at one period of embryonic life, the mesonephros never acts as an excretory organ.

DEVELOPMENT OF THE PERMANENT KIDNEY AND URETER IN MAN

The pronephros resembles in its structure the earlier forms of excretory organ of the lower vertebrates. It consists of a series of tubules which enclose a network of capillaries (A of Fig 1) at their proximal end and empty into a common excretory duct (primitive ureter) at their distal ends. They arise from segments which later form the cervical region in man. Their development and degeneration are completed between the third and fourth weeks of embryonic life.

¹ Embryology. Bergmann, Wiesbaden.

A little more caudally a second series of tubules develops forming the mesonephros. The proximal portion of each mesonephric tubule has an expanded end which is irrigated by a capillary network, the glomerular (B of Fig 1). At their distal ends the tubules empty into the primitive ureter now called the wolffian duct (also termed primary excretory duct) which grows caudally and opens into the cloaca (Fig 3). The mesonephros retrogresses towards the end of the third month of embryonic life. The secretory portion with its glomerulus disappears completely while a certain number of the collecting tubules remain to form a portion of the sex organs.

The metanephros appears in mammals very early in embryonic life as a substitute for the mesonephros. A glance at Fig 2 will be of aid in understanding the relation which this third generation of urinary tubules bears to its predecessors, the pro and mesonephros. The former has disappeared completely and the latter is rapidly retrogressing at the time the metanephros is developing. In the case of the pro and mesonephros, the secretory portion with its glomerulus corresponds more or less to the segments or somites of the embryo. The secretory portion however of the metanephros develops from an undifferentiated unsegmented cell mass termed the nephrogenic tissue situated well caudally. It receives a number of vessels from adjacent portions of the aorta during its period of development and ascent to its final position in the embryo.²

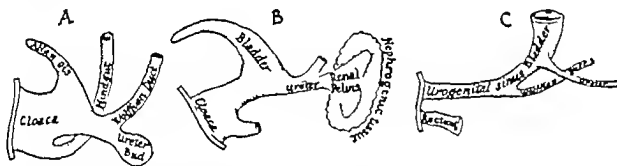


FIG. 3—Mode of origin of human ureter from the wolffian duct. (After Keibel and Mall.)

- A. Ureter arising as a bud from lower end of wolffian duct.
 B. Ureter growing in a cephalic direction into renal blastema (nephrogenic tissue) or metanephros.
 C. The wolffian duct has separated from the ureter. The former becomes the vas deferens and ends in the proximal portion of the urogenital sinus at the veru montanum and the ureter opens into the trigone.

The excretory duct of this cell mass or renal blastema is formed toward the end of the fourth week by a separate anlage in the shape of a hollow bud from the dorsal aspect of the mesonephric duct (wolffian or primary excretory duct). This ureteral bud is first seen (Fig 3) on the dorsal surface of the mesonephric duct. It soon grows cranially to enter the renal blastema which forms a cap (Fig. 3) around its distal expanded end which becomes flattened as the ureter lengthens and develops a cranial and caudal limb which represent the major calices. Later from the renal pelvis two other buds grow out, one dorsally and one ventrally. These four constitute the major calices. Each of these divides into two to four collecting tubules of the second order or minor calices (Fig 20). As

In the chapter on accessory polar vessels we shall see how some of these can persist into postnatal life.

a result of constant branching, tubules of the third and up to the thirteenth order are formed The height of this development is reached in the fifth month of fetal life Each of these tubules is surrounded or capped by cells of the nephrogenic tissue These cell nests become isolated, develop a lumen and a capillary network or glomerulus grows into the invaginated proximal end (Bowman's capsule) of the tubule, which opens at its distal end into one of the branches of the collecting tubules ³

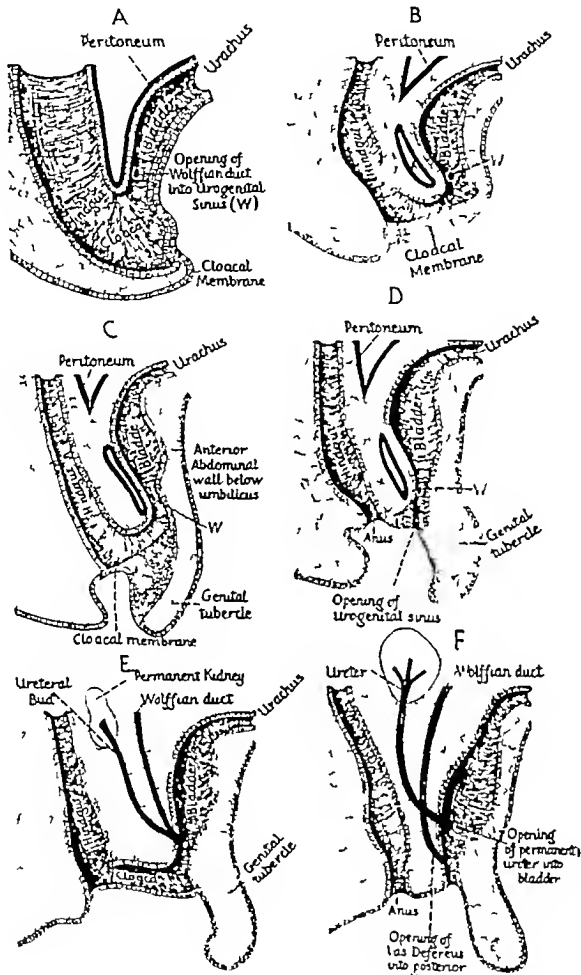


FIG 4 —Manner in which the cloaca is divided by the urogenital septum into an anterior portion or bladder and urogenital sinus, and a posterior portion or hindgut, can be followed from A to F inclusive (After Corning)

As the renal pelvis develops, each branch is surrounded in a fan-like manner by nephrogenic tissue so that a series of lobules are formed The cortex soon becomes differentiated from the medulla, at an early period

CHANGE IN POSITION OF THE KIDNEY DURING DEVELOPMENT

As the ureter lengthens, the permanent kidney (metanephros) moves from the pelvis into the abdomen (Fig 4) and comes in contact with the adrenal In embryos from 9-10 mm in length, less than four weeks old, the two renal blas-

³ In Chapter 37 on polycystic kidney, attention will be directed to the fact that the failure of this convoluted tubule to unite with the collecting tubule, results in retention of secretion and polycystic kidney

temas or metanephroi lie in the pelvis. As the embryo develops and the two ureters elongate the kidneys now composed of the divisions of the permanent ureter (B of Fig 3) and of the nephrogenic tissue or blastema gradually ascend so that the pelves lie opposite the interspace between the bodies of the second and third lumbar vertebral

In early embryonic life the hilus is on the ventral aspect of the kidney. As the latter moves upward (during the second month) rotation occurs so that the hilus comes to lie on the mesial border⁴ (See Fig 16)

DEVELOPMENT OF REPRODUCTIVE GLANDS AND THEIR DUCTS⁵

UNDIFFERENTIATED GONAD

The reproductive glands or gonads, appear in the human embryo as a proliferation (A of Fig 5) of the epithelial (mesothelium) covering on the antero-mesial side of the mesonephros or wolffian body at about the fourth week. This soon becomes a definite ridge or fold (genital), composed of a mixture of cells similar to those lining the primitive body cavity or coelum and cells which are more rounded and larger called primitive germinal cells. In sections at this period one can also observe lying in close proximity to this genital fold two ducts the wolffian and müllerian. The former we have seen under the development of the mesonephros to be the excretory duct of this intermediate type of kidney. It is not known whether the müllerian duct develops independently or from the wolffian duct, but it accompanies the latter at this period and empties like the wolffian duct into the urogenital sinus. Sections also show at the same period of development the transverse tubules of the mesonephros and its glomeruli (Fig 5)

This undifferentiated stage only lasts until the beginning of the second month only the median portion of the genital fold developing into the reproductive gland or gonad. The process of change in the undifferentiated gland (Fig 5) varies in the male and female. In the former (Fig 5) medullary cords grow inwards from the mesothelium and fill the entire reproductive gland. One can distinguish small undifferentiated supporting cells and others which are later developed into spermatogones. In the formation of the ovary no medullary cords are formed but both supporting and germ cells are formed in the mesothelium and wander into the mesenchyme of the reproductive gland to form the primary follicles.

The reproductive gland in both sexes becomes gradually separated from the mesonephros or wolffian body so that it soon lies free except for a narrow band or pedicle termed mesorchium in the male and mesovarium in the female.

DIFFERENTIATION INTO MALE AND FEMALE TYPES

THE GONADS

Up to the sixth or seventh week, the mass of cells which is destined to form the sex gland is termed the gonad because it is not yet differentiated into tissue.

⁴ See the Chapter 32 on anomalies of the kidney for failure of one or both kidneys to ascend and also section on faulty rotation for effect of nonrotation.

⁵ Only the development in the male type will be described in detail. That of the female type belongs in textbooks on Gynecology.

recognizable as ovary or testis. The development of the undifferentiated gonad into testis or ovary is shown in Fig 6. The schematic undifferentiated stage is shown in A of this figure.

FIG 5

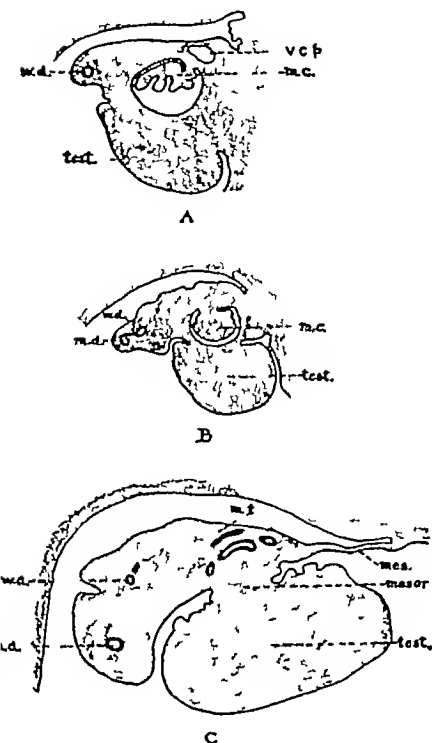


FIG 6

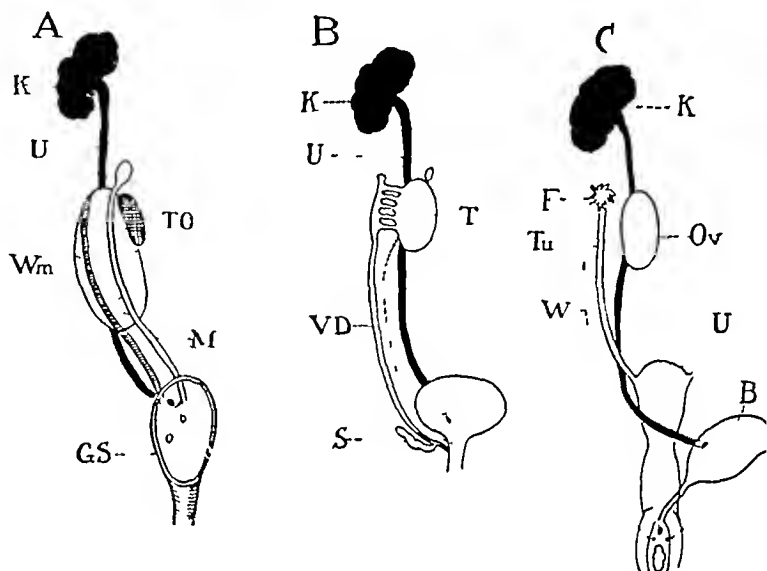


FIG 5—Portions of sections showing early development of the gonad in the male a Embryo of 12.5 mm b Embryo of 19.4 mm c Embryo of 50 mm Mes mesentery, mesor mesorchium, m t mesonephric tubules, m c malpighian corpuscles, m d mullerian duct, w d wolffian duct (After Felix and Franklin P Johnson)

FIG 6—Diagrams of development of gonads and their excretory ducts in both sexes

A Undifferentiated stage The long mesonephros or wolffian body (Wm) has gonad (TO) lying mesial to it. The ureter (U) is seen lying on the surface of the wolffian body and accompanied by the mullerian duct (M) empties into urogenital sinus (GS). The permanent kidney (K) has already reached a level higher than that of the mesonephros (wolffian body) and its excretory duct or permanent ureter has separated from the wolffian duct or primitive ureter (see Fig 33) and has its own opening into urogenital sinus.

B Differentiation toward male sex The gonad has become the testis (T). The transverse tubules of the caudal portion of the mesonephros become united with the rete testis and represent the efferent ducts and lobuli of the epididymis. The wolffian duct becomes the vas deferens and empties into the posterior urethra. The mullerian duct (M or A) degenerates, only its most distal end remaining as the utericle. The seminal vesicles develop from the lower end of the vas deferens at (S).

C Differentiation toward female sex The gonad becomes the ovary (OV). The cranial end of the mullerian duct (M of A) forms the fallopian tube (TU) while the caudal forms the uterus and vagina, with the corresponding portion of the mullerian duct of the opposite side F. The wolffian duct and transverse tubules of the mesonephros persist in rudimentary form (epoophoron and paroophoron).

MALE

1 The reproductive gland or gonad becomes the testis (T)

2 Some of the transverse tubules of the mesonephros or wolffian body (Wm in A of Fig 6) after union with the rete testis form the efferent ducts of the epididymis. This occurs about the tenth to twelfth week.

Remain Rudimentary 1 The wolffian duct becomes the body of the epididymis and the vas deferens (VD in B of Fig 6), and having become sepa-

rated from the permanent ureter, empties into the posterior urethra. The seminal vesicle develops on each side as a bud from the vas deferens

2 The upper (cephalic) end of the müllerian duct remains as the appendix testis of Morgagni. The greater portion of the müllerian duct disappears only the caudal portion remaining and forming the utricule with its fellow of the opposite side (see B of Fig 6)

Disappear Completely 1 The larger portion of the mesonephros and its glomeruli only a few transverse tubules developing into the efferent ducts of the epididymis as just described

2 The greater portion of the müllerian duct except the appendix testis and utricule

FEMALE

1 The reproductive gland or gonad becomes the ovary

2 The cranial portion of the müllerian duct forms the fallopian tube and the caudal portion unites with the duct of the opposite side, to form the uterus and vagina.

Becomes Rudimentary or Disappears. 1 Some of the transverse tubules of the mesonephros persist as the paroophoron, epoophoron, and as ducts of Gaertner

2 The wolffian duct disappears except portions of the epoophoron and paroophoron from the cranial end of the cord. The caudal portion disappears completely

The following table will be of service in remembering the fate of the various embryonic structures.

TABLE SHOWING DIFFERENTIATION OF GONADS AND EXCRETORY DUCTS

	Male Type	Female Type
Undifferentiated gonad	Testis	Ovary
Mesonephric tubules and glomeruli	Some tubules develop into efferent ducts of the epididymis.	In a few the tubules persist in rudimentary form (epi and paroophoron)
Wolffian duct	Forms body of epididymis, vas deferens, seminal vesicles, ampulla of vas and ejaculatory duct.	Disappears except as it may persist as ducts of Gaertner
Müllerian duct	Only rudiments at cranial and caudal (utricule) ends remain.	Forms fallopian tube and by union with duct of opposite side forms uterus and vagina.

DESCENT OF THE TESTIS

During development of the male reproductive gland or gonad, a fold of the mesenchyme at its caudal end becomes attached to the vaginal process of peritoneum forming thus a structure known as the gubernaculum. It was formerly held that this played an active part in the migration or descent of the testis from its position within the abdominal cavity (Fig 7) into the scrotum. This view is no longer tenable and the gubernaculum is now believed to play a passive rather than an active role.

The inguinal canal does not exist at the time the testis passes out of the abdomen into the scrotum so that it is incorrect to speak of a descent through the canal. Corning believes that the vaginal process plays a part by becoming shortened and later obliterated.

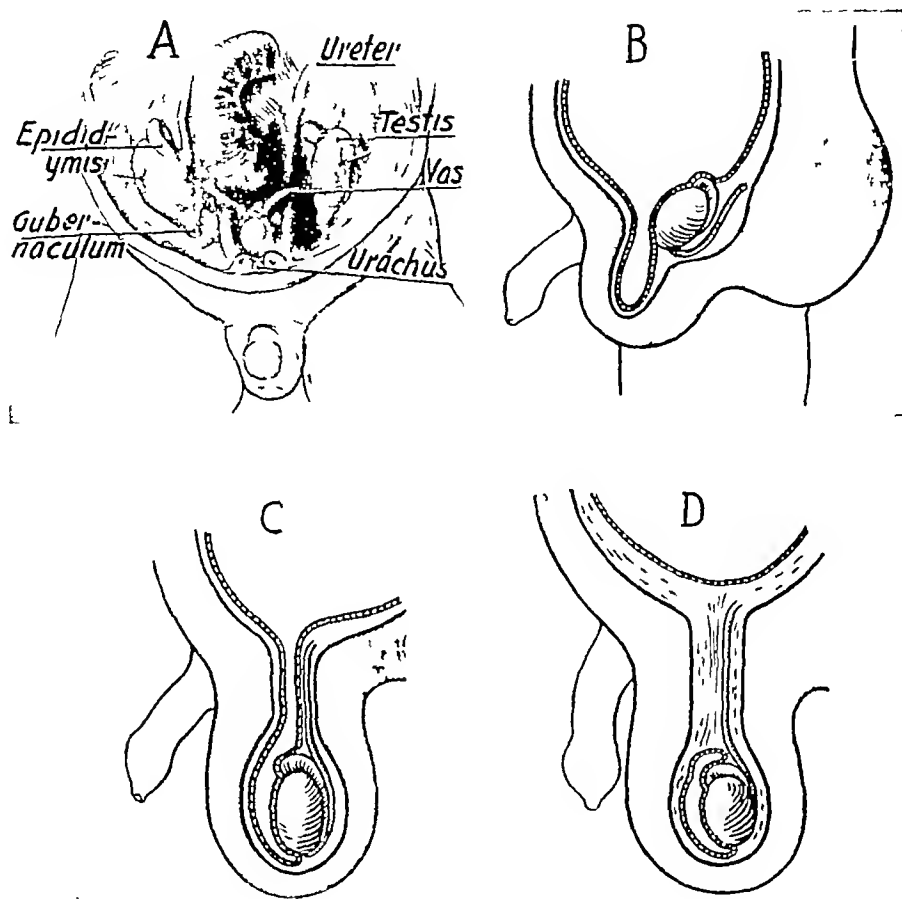


FIG 7—Steps in descent of testis After Corning and Stiedapansk
 A Location of testis in iliac fossa in a five months fetus
 B Testis about to enter inguinal canal
 C Testis in scrotum but vaginal process of peritoneum still patent
 D Vaginal process closed and tunica vaginalis completely formed

In spite of much difference of opinion in regard to the reasons for this migration of the testis, we know that the testis remains intra-abdominal, near the internal ring until between the fourth to sixth month but by the end of the ninth month of prenatal existence, it is in the scrotum. The variations of such a normal course will be fully considered under Nondescent of the Testis.

A review at this time of the meaning of certain embryologic terms will be of assistance in understanding the development, not only of the bladder, but of the urethra and its accessory glands as well.

Cloaca (Fig 4) This is the common receptacle or cavity into which the allantois, hind-gut and primary excretory duct (wolffian duct) terminate.

Cloacal Membrane (Fig 4) This separates the cloaca from the outside (Fig 4) and is formed by the fusion of a layer of epithelium derived from the lining of the cloaca i.e. of the entoderm, with a similar layer derived from the ectoderm.

Urorectal Septum (Fig 4) A diaphragm like membrane developing from the wall of the cloaca in a direction from above downwards and lying in the frontal plane, thus dividing the cloacal cavity into two portions, a posterior or dorsal from which the rectum develops, and an anterior or ventral, termed the vesicourethral anlage

Urogenital Membrane (Fig 4) This is the ventral portion of the original cloacal membrane which separates the urogenital sinus from the outside, just as the more dorsally located portion of the original cloacal membrane forms the anal membrane, to separate the rectum from the outside

Urogenital Opening (Fig 4) When the urogenital membrane breaks down by resorption early in embryonic life the innermost portion of the urogenital sinus becomes open to the outside along its ventral wall

Genital Tubercle or Pballus (Fig 4) This is the undifferentiated sex organ which arises from the anterior body wall just above the urogenital membrane. The elongation of this structure plays an important part in the development of the urethra in the male

Our reason for giving the above is that it will avoid much repetition

DEVELOPMENT OF THE BLADDER

The upper part of the vesicourethral anlage (or anterior portion of the divided cloacal cavity) enlarges to form the bladder. The allantois at the uppermost extremity of the newly formed bladder loses its lumen and is reduced to a solid cord, the urachus, extending to the umbilicus.

We have seen in the section on development of the kidney and ureter how the secondary or permanent ureters arise as buds (Fig 3) from the primary excretory (wolffian) ducts while the latter still terminate in the cloaca. With the development of the bladder, the permanent ureters separate from the wolffian ducts which have become greatly shortened, so that both acquire separate openings the former (permanent or secondary ureters) being carried upward into the bladder while the latter (wolffian ducts) remain more caudally situated in the lower portion of the vesicourethral anlage (true urethra) (Fig 3)

All of the bladder lining is derived from the entoderm (urethrovesical anlage), with the exception of a part of the trigone which is of mesodermal origin (from the absorption into the bladder wall and urethra of a portion of the wolffian duct). The connective tissue and muscular coats of the bladder are added, by a differentiation of the surrounding mesenchyme

DEVELOPMENT OF THE URETHRA AND ITS ACCESSORY GLANDS

TRUE URETHRA

The male urethra is composed of two portions (a) the true which lies above the opening of the genital (wolffian and müllerian) ducts and (b) the urogenital sinus which lies below this point. The first named or true urethra is the lowermost, narrow portion of the vesicourethral anlage from whose upper portion we have just seen that the bladder is developed. This "true urethra" forms

almost the entire urethra in the female, while in the male, it represents only that portion of the prostatic urethra up to the verumontanum

UROGENITAL SINUS

This urogenital sinus (Fig 3) forms the larger portion of the urethra in the male. It begins at the orifices of the wolffian and mullerian ducts and extends to the urogenital membrane (ventral portion of cloacal membrane). As the cloacal (genital) tubercle grows, the urogenital sinus elongates with it, much more so in the male than in the female.

A division of the urogenital sinus as suggested by Felix into a phallic and a pelvic portion for the early developmental stages is of descriptive value according to Johnson, but has no true embryologic significance. The phallic portion is limited anteriorly (pubically) by the urogenital membrane (ventral portion of divided cloacal) which breaks down by resorption so that the phallic portion is open to the outside along its ventral wall (Fig 11). In the male, this cleft or urogenital opening (primitive) in the urogenital membrane closes by a coalescence of the lips of the urethral gutter or groove.

In the female, the primitive urogenital opening remains as a cleft beneath and along the ventral (rectal) surface of the cloacal tubercle. Its walls do not fuse as in the male but remain open to form the vestibule. The further development of the urethra in the male, consists in its continued elongation and in the development of its glands. Both of these have been recently studied in a most thorough manner by Lowsley, Johnson⁶ and others. Johnson directs attention to the fact that the anatomical divisions of the urethra into prostatic, membranous and cavernous, or the clinical division into anterior and posterior, have no importance from the embryologic viewpoint. We shall follow Johnson's and to some extent Lowsley's observations.

Prostatic Urethra. This is made up of the whole of the "true" urethra and part of the urogenital sinus. Along its floor is seen a longitudinal fold, the crista urethralis or verumontanum. Through it the fused mullerian ducts, the wolffian ducts and numerous tubules of the posterior and lateral portions of the prostate reach the urethra (Fig 9).

ACCESSORY GLANDS

Prostate. This is first seen in a 55 mm embryo as knoblike solid epithelial sprouts from the anterior (ventral), lateral and posterior walls of the urethra. These tubules grow rapidly in length, acquire a lumen and begin to branch (Fig 9). Lowsley believes that the tubules are separable into five groups (middle, right and left lateral, posterior and anterior) which eventually become the corresponding lobes of the fully developed prostate. Johnson was unable to find such a division into groups with the exception of the middle lobe which is formed by the posterior tubules lying behind the veru. He found that the tubules of the anterior, posterior and lateral lobes lie in close approximation with no suggestion of septa between them. The further development of the prostate (Fig 10) consists in the further growth and branching of its glands, in the transformation of its epithelium into a secreting one and in the differentiation of its mesenchyme into connective tissue and muscular elements. In the female, pro-

⁶ Jour Urol 4, 447

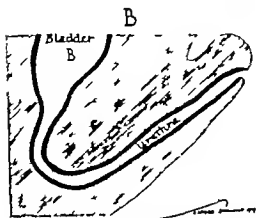
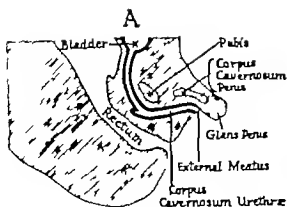


FIG. 8—Development of human urethra. (After Franklin P. Johnson.)

A. Early stage. The urogenital sinus is developing toward the surface of the body along the inferior aspect of the genital tubercle.

B. Still more advanced stage of A. showing almost complete development of the urethra.



FIG. 10—Posterior view of a wax reconstruction of the urethra of an embryo of 130 mm (after F. P. Johnson) to show development of prostatic and urethral tubules and seminal vesicles (Courtesy Dr. H. H. Young and D. M. Davis.) W. B. Saunders Co.

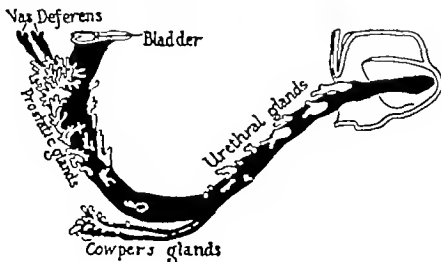


FIG. 9—Mode of development of the urethral Cowper's and prostatic glands in a 140 mm embryo (After Franklin P. Johnson.)

static tubules develop in a similar manner but in smaller numbers compared to those in the male. They are found along the urethra and about the urethral orifice in the vestibule. They form the urethral and paraurethral (Skene's) glands in the female.

Cowper's Glands These are seen comparatively early as solid, cylindrical sprouts of epithelium directed towards the bladder and parallel to the urethra in its cavernous portion (Fig 9), which begins at the bulb. With continued growth the ducts acquire lumens and branch terminally. Finally, their epithelium is converted into one of the mucus-secreting type.

Bartholin's glands in the female correspond to Cowper's glands in the male. Their ducts branch but they never become as elongated as in the male.

Glands of Littre (small urethral glands) and **Lacunae** (of Morgagni) Johnson found that these appear in a 55 mm (crown rump length) embryo (male). They are at first knob-like, becoming tubular later, branching and acquire lumens. They were found to be always confined (Fig 9) to the anterior two-thirds or half of the urethra, beginning just behind the fossa navicularis. They are arranged in longitudinal rows corresponding to the furrows between the mucosal folds. The majority of the ducts are directed vesically, but some are directed vertically or obliquely towards the glans penis. They occur most commonly along the ventral (pubic) wall of the urethra. There are fewer but similar glands in the female urethra.

The lacunae (of Morgagni) differ in not having secretory cells, being lined with epithelium similar to that of the urethra. Johnson found that they occurred very inconstantly in the male embryo.

DEVELOPMENT OF THE EXTERNAL GENITALIA⁷

The external genitalia begin to take the form of male or female during the sixth week. The specific ovarian or testicular hormones lead to the differentiation of the internal and external sexual organs into male and female. Other glands of internal secretion also play a part. It is well known that hyperplasia of the adrenal cortex is associated with marked change of secondary sex characteristics in the female.

In embryos of 8 mm, a rounded genital tubercle (A of Fig 11) forms in the midline of the ventral body between the umbilical cord and tail. On its caudal slope, it bears the shallow urethral groove, whose margins are slightly elevated as urethral folds. At the end of the seventh week, the genital tubercle has become elongated into a cylindrical phallus with a glans and a constricted neck. At the base of the phallus on each side and separated from it by a groove, are rounded lateral ridges, the genital ridges (Fig 11) or labioscrotal swellings.

In the male, the edges of the urethral groove gradually fold together (B of Fig 11) and change an open urogenital sinus into the tubular urethra, the fused edges forming the raphe. The separated labioscrotal swellings coalesce to form the scrotum. The shaft of the penis elongates and by the end of the fourteenth week, the urethra has closed as far as the glans. The changes are slower, the urethral groove remaining an open vestibule (C of Fig 11). The labioscrotal

⁷We are indebted to the monograph "Genital Abnormalities, etc.," by Dr. Hugh H. Young (Williams and Wilkins Co. 1937) for much of the material in the revision of this section.

swellings fuse in front of the anus to form the posterior commissure while the lateral portions form the labia majora (D of Fig 11) The urethral folds fail to unite as in the male and form the labia minora

DEVELOPMENT OF SEMINAL VESICLES EJACULATORY DUCTS AND VASA DEFERENTIA

The seminal vesicle appears in the thirteenth week as a bud from the wolffian duct (later vas deferens) close to its distal end i.e. near the neck of the bladder They grow back and laterally so that at birth they extend to the base of the vesical trigone Five branches from the main lumen are seen at this

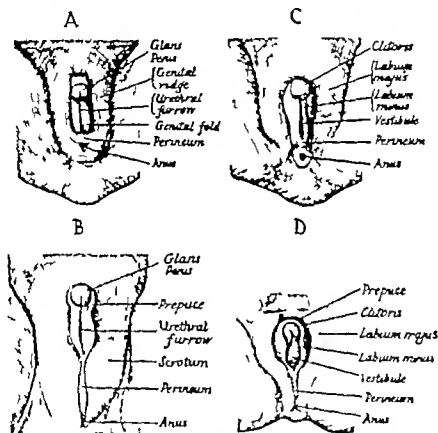


FIG. 11.—Mode of differentiation of external genitalia in the male (A and B) and female (C and D) (After Pollier and Charpy.) See text

time all communicating. The end duct of the seminal vesicle receives the ampulla of the vas deferens and is then continued as the ejaculatory duct. The latter is of comparatively large size in early fetal life.

The two ejaculatory ducts pass through the posterior wall of the prostatic urethra with the utricle and these three structures at an elevation in the floor of the urethra, called the verumontanum. Occasionally one or both ejaculatory ducts empty into the utricle.

The vasa deferentia correspond to the wolffian duct and lie quite close to each other behind the middle of the trigone early in embryonic life, enlarging considerably at the level of the internal vesical sphincter to form the ampulla which like the seminal vesicle has assumed its adult form at about the twenty-fifth week, so far as the general form and accretion are concerned.

CHAPTER 2

ANATOMY

THE KIDNEYS

LOCATION

FIXATION OF THE KIDNEYS

CLINICAL APPLICATION

FORM AND SIZE OF THE KIDNEY

STRUCTURE OF THE KIDNEY

VASCULAR AND LYMPHATIC SUPPLY OF THE KIDNEY

INNERVATION OF THE KIDNEYS

THE URETER

DIVISIONS

STRUCTURE OF THE URETER

VASCULAR AND LYMPHATIC SUPPLY OF THE URETER

THE BLADDER

MUSCULATURE OF THE BLADDER

RELATIONS AND FIXATION OF THE BLADDER

VASCULAR AND LYMPHATIC SUPPLY OF THE BLADDER

INNERVATION OF THE BLADDER AND POSTERIOR URETHRA

THE URETHRA

DIVISIONS

PELVIC AND PERINEAL FASCIAE AND MUSCLES

THE PENIS

THE PROSTATE

THE SCROTUM

THE TESTES

BLOOD AND LYMPHATIC SUPPLY

THE EPIDIDYMIS

THE VAS DEFERENS

THE KIDNEYS

LOCATION The kidneys, one on each side of the dorsolumbar portion of the spine, lie on the posterior abdominal wall resting upon the aponeurotic coverings of the quadratus lumborum, the outer edge of the psoas and the diaphragm (Fig 12) The upper border on the right side lies opposite either the middle of the body of the eleventh or upper edge of the twelfth dorsal vertebra and the lower border

FIG 12

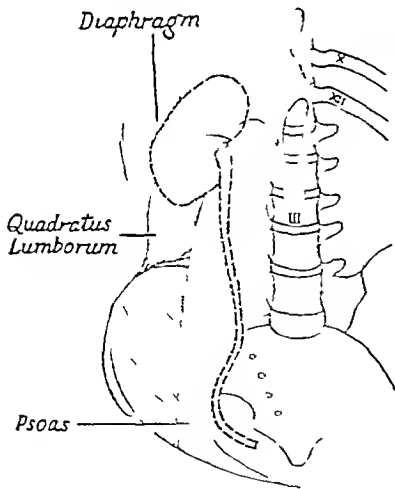


FIG 13



FIG 12—Relations of right kidney and upper ureter to structures behind them (After Poirier and Charpy) Note intimate relation of lower portion of diaphragm, quadratus lumborum and psoas to kidney and manner in which the lumbar and iliac portions of the ureter lie upon the psoas

FIG 13—Plain film showing relation of gall-bladder (GB) to right kidney (K) The shadows of the respective viscera have been outlined in white Note the relation of the right lobe of the liver to the right kidney in this radiographic print

at the level of the upper edge or even the middle of the body of the third lumbar vertebra On the left side, these respective borders (upper and lower) are located 1 to 2 cm higher In radiographic films which show the kidney shadows, the location of these upper and lower borders are especially well seen

The hilus located at the middle of the mesial border of each kidney lies usually opposite the space between the transverse processes of the first and second lumbar vertebrae. This is of importance clinically because shadows at this level correspond very frequently to calculi located at the outlet of the renal pelvis.

The Gall Bladder Another feature of clinical interest in connection with the normal locations of the right kidney is the fact that the gall bladder lies in a more anterior plane directly over the kidney (Fig. 13).

At times, as we shall see later under Renal Calculi, it is necessary to study the relation of a cholecystogram to that of the suspected renal calculus shadow in



FIG. 14—Location of kidneys as seen in patient with generalized visceroptosis. Note low position of right kidney and of lower edge of right lobe of liver in relation to crest of ilium.

order to exclude the presence of a biliary calculus. In children and in adults with a long thorax the kidneys may be normally located at a lower level on both sides, especially on the right side.

Relation to the Surface of the Body It is of considerable importance to be able to visualize the location of the kidneys in relation to the surface of the body, as shown in Fig. 15A and 15B. It will be noted that on the right side the lower border is at the level of a line drawn transversely through the umbilicus and that on both sides the greater portion of the kidney lies well within the bony thorax, which affords great protection against any force exerted against the anterior abdominal wall. There are certain surface landmarks which it is well to keep in mind in relation to the location of the kidneys because they will be constantly

referred to in speaking of diseased conditions of the upper urinary tract. These are the following:

1 "COSTOVERTEBRAL" ALSO TERMED THE "RENAL" ANGLE. This is a point (Fig 15) corresponding to the junction of the last rib and outer (lateral) border of the erector spinae muscle. In cases of renal infection, tenderness on pressure is often first found at this point.

2 "ILIOCOSTAL SPACE." This is the area between the last rib and crest of the ilium (Fig 15). Its average width is 7 cm. and it is in this space that rigidity and tenderness are often observed in kidney infections.

3 CREST OF AND ANTERIOR SUPERIOR SPINE OF ILIUM. Both of these are of clinical interest and with the two landmarks just mentioned, are constantly referred to in kidney and ureter (upper portion) operations.

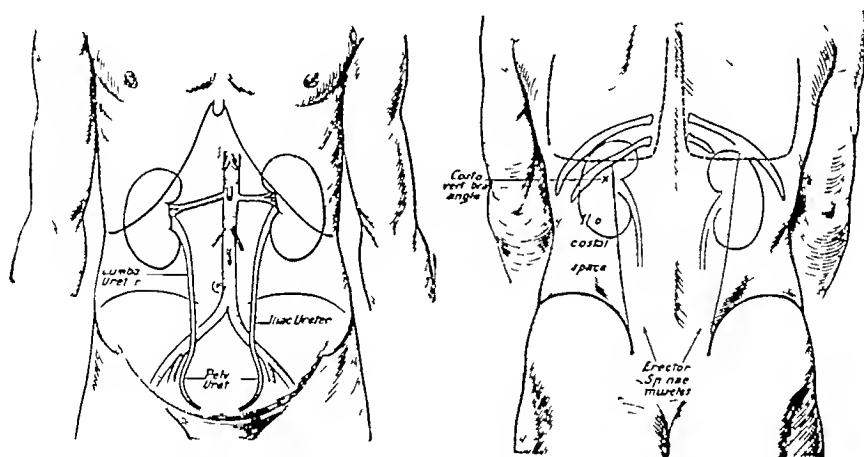


FIG 15

Left (A)—Location of kidneys and ureters projected on anterior abdominal wall.
Right (B)—Projection on posterior aspect of trunk.

Axis of the Kidneys and Direction of Hilus. The long axis of each kidney is not vertical but directed obliquely down and outwards (Fig 12) so that the axes would meet if prolonged mesially. There is also some degree of rotation of the kidney in a frontal plane so that the inner borders with their hilum do not face entirely mesially. We have seen in the chapter on embryology that the hilum faces ventrally at first and then undergoes rotation so as to be directed towards the midline. When a kidney fails to rotate in this manner or undergoes excessive rotation, the pelvis may remain on the ventral surface, or be directed posteriorly or even laterally and yet the kidney be in every respect normally located and developed. This abnormal (faulty or excessive) rotation is well seen in Fig 19 and will be referred to again in the chapters on Radiography and 'Anomalies of the Kidney.' A knowledge of the existence of such deviations in the degree of rotation of the kidney is of the utmost importance in the interpretation of normal pyelograms.

FIXATION OF THE KIDNEYS

In order to understand how the kidney is held in position and has only a relatively slight normal range of mobility, it is necessary to study its fascial and adipose envelopes in horizontal and sagittal sections.

RENAL FASCIA

Horizontal Section The renal fascia is a part of the fascia propria which reinforces the parietal peritoneum being placed between this structure and the aponeuroses covering the abdominal muscles and diaphragm. When it reaches the outer border of each kidney it divides into a prerenal (anterior) and a retrorenal (posterior) layer to envelop the kidney. The latter is also termed the fascia of Gerota or of Zuckerkindl. The prerenal leaf is much thinner and less resistant than the retrorenal leaf or fascia. At the inner (mesial) border of each kidney these two leaves unite and fibrous extensions enclose the blood vessels and lymph nodes of the pedicle. Some anatomists, e.g. Gerota held that these fascial extensions united across the front of the aorta and vena cava (Fig. 16) with similar tissue from the opposite side so that there was more or less free communication between the two sides. Augier in the 1925 edition of Poirier and Charpy denies this because

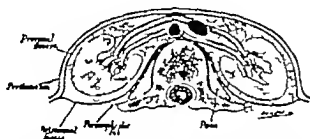


FIG. 16.—Horizontal section at level of kidneys, showing how the pre- and retrorenal fasciae unite along outer border of kidney thus enclosing the perinephritic fat. (See text.) The paranephritic fat lies between the psoas and the posterior surface of the retrorenal fascia.

there are no recorded cases¹ in which a perinephritic abscess of one side communicated with a similar condition on the opposite side of the spine. Toward the spine, the retrorenal fascia is continuous with the periosteum of the vertebra.

(b) **Coronal Section.** The two leaves of the renal fascia fuse at the upper pole of each kidney but separate again to enclose the corresponding adrenal. They unite again above the latter (Fig. 17) and become continuous with the aponeurotic covering of the diaphragm. At the lower pole of each kidney the pre- and retrorenal leaves fuse incompletely so as to enclose the ureter down to the base of the bladder thus forming a periureteral sheath or fascia.

PERI AND PARARENAL FAT LAYERS AND THEIR RELATION TO THE RENAL FASCIA

A layer or cushion of fat the perinephritic or perirenal separates the two leaves of the renal fascia from the true capsule of the kidney. This perinephritic fat only exists after the tenth year before that only isolated lobules of fat are seen. In adults it may reach a thickness of 2 to 3 cm. The fat is more developed on the posterior than on the anterior surface of the kidney and especially so around the lower pole. At the hilus of the kidney the fat extends inwards with the vessels and surrounds the pelvis and its calices (Fig. 24). The term "perinephritic capsule" then strictly speaking means the fat lying between the true capsule and the leaves (pre- and retrorenal) of the renal fascia. This has also been called the "kidney bed." There are many fibrous lamellae which pass from

¹We have observed at necropsy of a case of carcinoma of both kidneys, that there was continuous infiltration of tumor tissue from one side to the other.

the inner surface of these two leaves of the renal fascia to the capsule (true or fibrous) of the kidney. Between the retrorenal fascia and the aponeurotic covering of the muscles upon which the kidney lies (quadratus lumborum, psoas and diaphragm) is another layer of fat which is termed the pararenal, thus forming an additional cushion (Fig. 16) of fat behind the kidney.

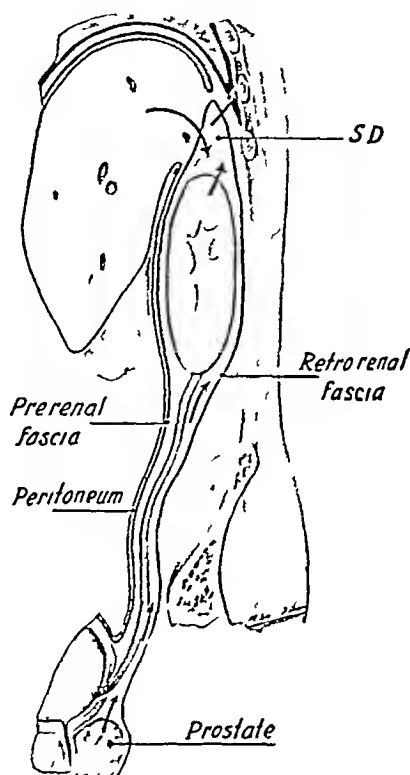


FIG. 17—Coronal section to show how infection (indicated by arrows) can travel from prostate and vesicles to kidney in periureteral sheath. It also shows route of infection from kidney and liver, to subphrenic space (SD) and pleural cavity.

CLINICAL APPLICATION

1 **Fixation of the Kidney** Although the peri- and pararenal fatty layers play a part in the fixation, it is minimal in comparison to that played by the renal fascia. The latter through its fusion with the aponeurotic covering of the diaphragm (Fig. 17) above the kidney and its fibrous extensions to the fascial coverings of the large abdominal vessels, undoubtedly is the chief factor in fixation of the kidney.

2 **Relation of Kidney and Its Enclosed and Surrounding Fat to Infection** Infection not infrequently extends from the kidney to the fat surrounding it (perinephric). Suppuration in this space (termed perinephritic abscess) may be quite localized or diffuse. The diaphragm may be pushed upwards if the pre- and retrorenal leaves of the renal fascia are widely separated or if the pus escapes, through perforation of either of these leaves, into the pararenal fat.

Primary infection (usually hematogenous) may also occur in this paranephric fat but is rare.

Infection may extend either downwards along the ureter or upwards from the pelvic viscera (especially the prostate) because of the free communication of the perinephric and periureteral spaces (Fig. 17). In cases of long standing infec-

tion the perinephric fat is replaced by organized inflammatory tissue so that one cannot distinguish between the renal fascia and true capsule

FORM AND SIZE OF THE KIDNEY

1 Form. The kidney has the contour of a bean with an upper quite rounded and a lower less rounded pole, an outer (lateral) convex and an inner (mesial) concave margin. The latter at its center has a notch, the hilum, which is the opening or entrance to the renal sinus (see below)

VARIATIONS OF FORM These are not uncommon, e.g., the kidney may be very short or very long. Its upper half may be much larger than the lower or vice versa. There may be an apparent complete separation into an upper and lower half both supplied by the same pelvis. (See Fig 18)



FIG. 18—Unusual form of human kidney, almost complete separation into an upper and lower half but with a single pelvis and ureter (Rayer)

2 Surfaces There is an anterior (ventral) convex and a posterior (dorsal) almost flat surface. As a rule the surfaces are smooth i.e. except when the fetal lobulations persist.

3 Direction of Hilus In the embryo the hilus (and the renal sinus) faces ventrally i.e., is on the anterior or ventral surface (Fig 19). During the ascent of the kidney the organ rotates so that when it reaches its permanent location, the hilum is directed mesially and almost directly toward the midline.

Variations of normal direction of hilus (faulty or excessive rotation) It is of much importance clinically to know that the kidney in its ascent during embryonic life may fail to rotate or may rotate excessively. If it rotates insufficiently the hilus (and renal sinus) may be on the anterior surface (Fig 19). This is a common finding in cases of dystopia² and in horseshoe kidneys but it may occur in an otherwise normally placed and developed kidney. In the chapter

²The terms dystopia is less frequently used than Ectopia.

Under the heading "Double Kidney" we will discuss reduplication of the renal pelves and ureters. In the type of kidney described above there is only one pelvis.

on Anomalies of the Kidneys is shown a kidney which has rotated a little farther than those whose hilus faces ventromesially. A degree of rotation in which the hilus has rotated so as to face mesially is shown in Chapter 32. In comparison to the preceding instances of insufficient rotation, the most common direction of the hilus is shown in C of Fig. 19. Just as there may be insufficient so excessive rotation can occur, the hilus (and renal sinus) facing posteriorly (E of Fig. 19) or laterally (F of Fig. 19). These variations from the normal degree of rotation are of great

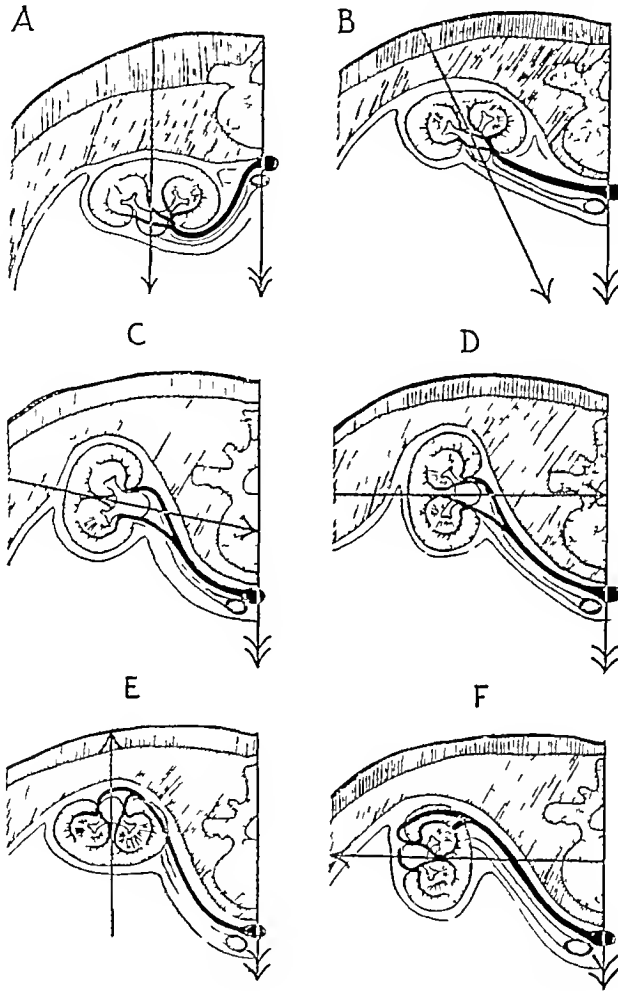


FIG. 19—Stages showing normal degree of rotation as well as faulty and excessive degrees of rotation of the human kidney (After Max Broedel)

- A Early embryonic stage Hilus faces ventrally
- B Slightly more advanced stage
- C Hilus faces more towards midline. This is the normal for the human being
- D Beginning of excessive rotation Hilus faces directly towards midline of body
- E Excessive rotation Hilus faces dorsally
- F Hilus faces laterally, so that vessels must either pass across anterior or posterior border in order to reach the hilus

importance in the interpretation of pyelograms (see Chapter 7 on Radiography) and in operations on the kidney because the vessels enter the hilum after winding around the inner (mesial) or outer (lateral) borders according to the degree of insufficient or excessive rotation.

4 Color, Size and Weight The normal color is reddish brown. The average length of the kidney is 12 cm, the breadth 6 cm and thickness 3.9 cm (Broedel). The average weight when physiologically distended is 168 gm.

STRUCTURE OF THE KIDNEY

(a) The hilus is a notch at the middle of the inner border which serves as the entrance or opening of a cavity, the renal sinus containing in addition to the renal pelvis and its calices the blood vessels, nerves and lymphatics of the kidney. The remaining space of the renal sinus is filled out by fat which is continuous with that enveloping the kidney and its vascular pedicle. Normally there are two lips of equal size which form the anterior and posterior margins of the hilus. In insufficiently or excessively rotated kidneys it is not uncommon to find

FIG. 20

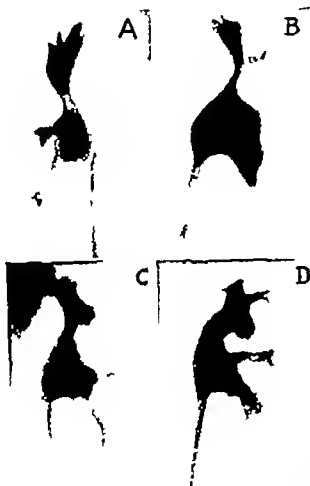


FIG. 21



FIG. 20—Pyelogram showing most typical variations of ampullary type of human renal pelvis.
FIG. 21—Pyelogram of pelvis with long upper major calyx as shown in A and B, into various types of funnels as shown in C and D.

inequality in the development of these lips of the hilus. This is of importance to know when searching for the posterior aspect of the renal pelvis preparatory to performing a posterior pyelotomy.

(b) The renal pelvis and its calices. Our views as to the type of renal pelvis in man have been greatly changed as the result of pyelography (see Chapter on Radiography) and the study of kidneys removed at operation. There are two basic types (Fig. 20 and 21) as follows:

(a) The ampullary consists of a pelvis proper and two or more major calices from which a variable number of minor calices arise (Fig. 20).

(B) THE BIFID in which there is almost complete absence of a pelvis proper, due to the fact that the ureter divides almost immediately into two major calices and these into a variable number of minor calices (Fig 21)

There are many variations of each of these two basic types, as well as transitions from one to the other

IN THE CLASSICAL AMPULLARY TYPE, there is a pelvis proper from which a superior and an inferior major calyx arise. As a rule, there is an additional middle major calyx, which may arise directly from the pelvis proper or from either the superior or inferior major calyx, usually the latter. The length and width of these major calices varies greatly, the superior being usually quite long and narrow. The number of minor calices varies from four to twelve, the average being eight.

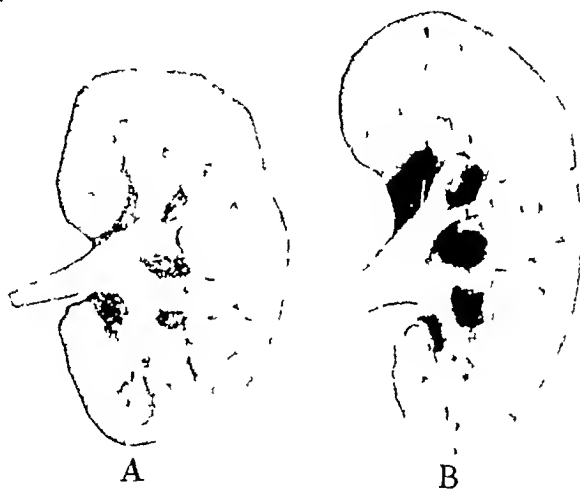


FIG 22—A Intrarenal pelvis. Practically the entire pelvis proper lies within the renal sinus, only a small portion extending distal to hilus of kidney.

B Combined intra- and extrarenal pelvis. Equal portions lie proximal and distal to the hilus. The removal of calculi through a pyelotomy incision in pelvis of the intrarenal type is far more difficult than in those of the second variety.

Each minor calyx (Fig 20) consists of a narrow neck or canal connecting it with the major calyx from which it arises and an expanded terminal portion or fornix with a cup-shaped depression to receive one of the papillae (see below) of the parenchyma. Occasionally a small calyx may arise directly from the fornix, a fact to be remembered in the interpretation of pyelograms.

There are three types of ampullary pelvises according to their relation to the hilus.

(a) *The intrarenal type*, the pelvis proper lies entirely proximal to the hilus, i.e., within the renal sinus as shown in (Fig 22).

(b) *The combined intra- and extrarenal type*. Here the pelvis proper lies partly in the interior of the kidney and partly outside of it as in (Fig 22).

(c) *The purely extrarenal pelvis* in which the ampullary portion or pelvis proper and the major calices lie entirely distal i.e. outside of the hilus and only the minor calices lie in the renal sinus.

These anatomic data are of great value, not only in the interpretation of pyelograms, but in the performance of such operations as pyelotomy, pyeloplasty, etc.

The bifid type is of interest because there are only two major calices with only a relatively small intervening pelvis proper. The division of the ureter may take place just external to the hilus or within it, i.e. in the renal sinus.

In Chapter 7 on Radiography, the pyelographic findings in the many variations of the normal human renal pelvis, will be considered in greater detail.

The wall of the renal pelvis and its calices consists of three layers, an epithelial lining, a muscular and an outer fibrous. These are continuous with similar coats of the ureter. At the base of the renal papillae, these layers are reflected on the surface of the papilla, the point at which the reflection occurs being termed the "niche." The muscle fibers are arranged in two layers (longitudinal and circular) in such a manner as to propel the contents of the minor calices towards the pelvis proper. This can be especially well studied during renal fluoroscopy (see Chapter 7 on Radiography).

The average capacity of the adult renal pelvis is 7.5 cc. but it is not unusual to see variations from 3 cc. to 10 cc. under normal conditions.

THE RENAL PARENCHYMA

Macroscopic In a longitudinal section dividing the kidney into an anterior and posterior half one sees the following:

1. The **FIBROUS CAPSULE** loosely attached to the cortex and firmly to the peri-renal fascia, by strands of fibrous tissue.

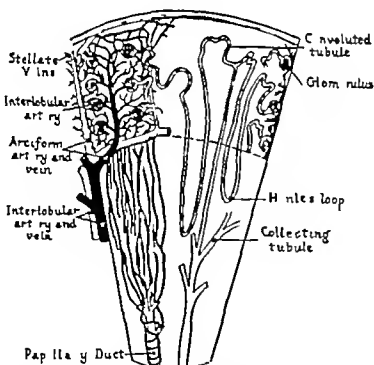


FIG. 23.—Diagram of relation of blood vessels of kidney to tubules and also of how a tubule is formed, from beginning at glomerulus, to termination in collecting tubule (Handbuch für Urologie.)

2. The **CORTX AND MEDULLA**. The cortical portion of the kidney is the outer (peripheral) granular portion and the medulla the more central striated part. The medullary portion has a number (four to eighteen with average eight) of pyramids with broad bases and blunt points the papillae. The tip of each

papilla is perforated (area cribrosa) to correspond with the openings of the collecting tubules. In a simple papilla there are ten to twenty-four of these, while in a compound one, this rises to thirty or even thirty-eight. The cortex extends from the base of the pyramids to the capsule and also dips in between the pyramids (Fig. 28) to come in contact with the sinus.

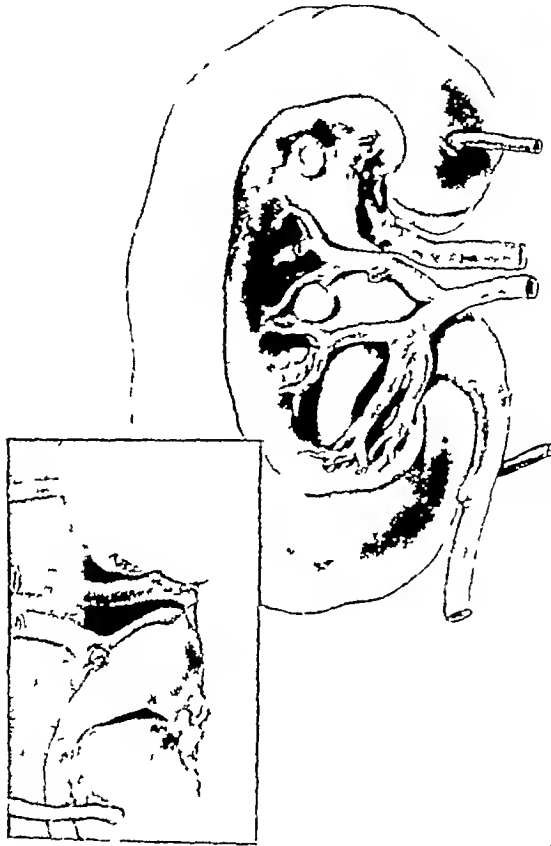


FIG. 24 —Anterior and posterior relations of branches of renal artery to pelvis proper and its calices. Note that the vessels lie in intimate relation with the anterior aspect of the pelvis proper and pass to the parenchyma on either side of the calices. The specimen also shows a superior and inferior polar artery.

MICROSCOPIC³ The urinary tubule (Fig. 23) arises at the malpighian corpuscle and ends at the lamina cribrosa of the corresponding papilla (See above). Its average length is 6-8 cm. It consists of the following portions:

- (a) A very narrow neck
- (b) The first or proximal convoluted tubule which is larger and more tortuous
- (c) Henle's loop which dips into the medulla but ends in the cortex
- (d) The second or distal convoluted tubule
- (e) An intermediate portion or junctional tubule
- (f) A collecting tubule. Up to this point there is no anastomosis of the tubule with any other but in the pyramid 4000 to 6000 collecting tubules unite to form fifteen to twenty tubes at the area cribrosa.

³ This is so thoroughly considered in our standard text-books of anatomy and histology that only the course of the tubules will be given.

VASCULAR AND LYMPHATIC SUPPLY OF THE KIDNEY

Arteries (Figs 24 26 and 27) There is usually only a single renal artery for each kidney but there may be more. As many as five arteries have been reported. Zondek states that more than one renal artery is found in about one of every three individuals. They may be close together (Fig 25) or as much as 3.5 cm apart. The main renal artery before it enters the hilum gives off

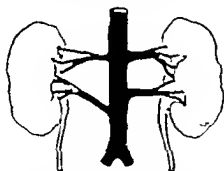


FIG. 25—Front view showing two main renal arteries on both sides. A superior polar artery arises from the upper of the two main renals on both sides. Note ampullary type of pelvis on the right and bifid type on the left side.

branches to the fat around the kidney and to the adrenal. At times these branches are torn during delivery of the kidney and retract making it difficult to ligate them.

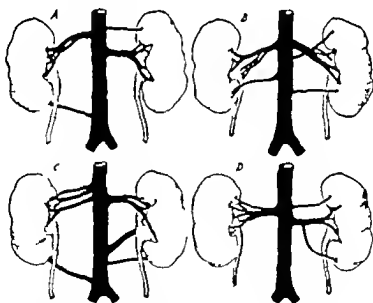


FIG. 26—Most frequent types of polar arteries.

- A. Note inferior polar to right kidney lying behind ureter and superior polar to left kidney.
- B. Inferior polars on both sides passing in front of the ureter. There is also a superior polar on the left side.
- C. View from behind showing an inferior polar arising close to the bifurcation of the aorta and on the opposite side, an inferior polar arising a little higher up.
- D. Shows a superior polar arising from main renal on one side and on the other an inferior polar arising in a similar manner as well as a superior polar arising directly from the aorta.

In about one out of seven kidneys there are separate arteries to the upper or lower poles or both (Fig 26). The former (superior polar) arise either directly from the aorta or from the main renal. The inferior polar arises either from the aorta just above its bifurcation (Fig 26) or from the common iliac,

or from the main renal. These supernumerary or accessory vessels are of interest because (a) of the danger of quite severe bleeding if their possible presence is not kept in mind during kidney operations and (b) because of the part which the inferior polars play in relation to ureteral obstruction.

Just before reaching the kidney the renal artery divides into three branches (Fig. 27). Two of these (the prepelvic) cross the anterior aspect of the renal pelvis supplying the anterior two-thirds of the kidney. The third or retropelvic passes directly to the angle of junction of the posterior aspect of the renal pelvis and the posterior lip of the hilus and forms an arch (Fig. 28) beneath this lip before entering the parenchyma to supply the posterior fourth of the kidney.

FIG. 27

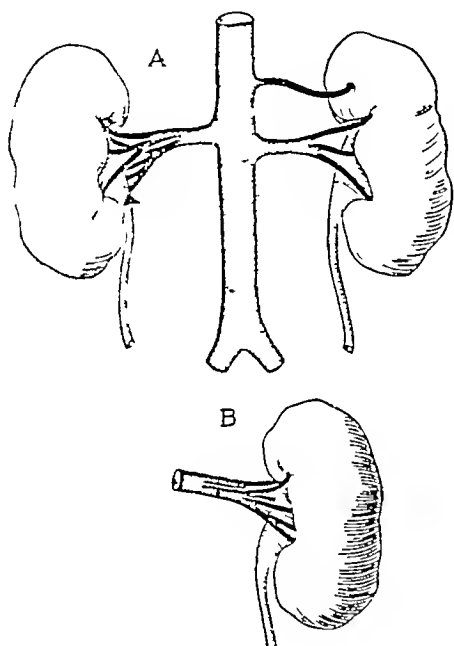


FIG. 28

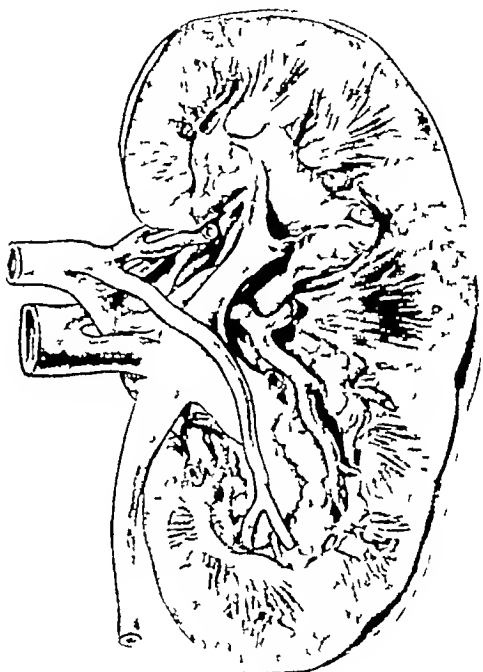


FIG. 27—Division of the main renal artery into an equal number of pre- and retropelvic branches.

A View from in front. On the left side an upper polar artery is seen.

B View from behind showing that almost the entire posterior aspect of the renal pelvis is in contact with branches of the main renal artery. This anatomical condition is infrequent but must be borne in mind during such operations as pyelotomy.

FIG. 28—View of kidney with posterior half removed, showing relation of retropelvic artery to posterior aspect of intrarenal pelvis (See Fig. 22.) Note relations of cortex and medulla to renal sinus and the presence of fat around the vessels and calices. The specimen also shows the relation of the main renal vessels to the anterior aspect of the renal pelvis so that its posterior aspect is usually avascular (See Chapter 52.)

In the section on technic of anterior and posterior pyelotomy, we will discuss the various anomalies of the pre- and retropelvic vessels (arteries and veins) which must be kept in mind in performing such an operation. Within the renal sinus the arteries divide again in a radiating manner, penetrating the fat between the calices to enter the parenchyma close to the bases of the pyramids (Fig. 24). Here an arch is formed from which straight vessels run directly to the capsule, oblique branches supplying the glomeruli (Fig. 23). These cortical arteries are terminal i.e. they do not anastomose. Some of them, however, penetrate the fibrous capsule to anastomose with the vessels of the fatty capsule. Each pyramid (Fig. 23) receives four or five arteries from different branches of the

main renal hence the vascular supply is not as easily blocked here as in the cortex. Both aseptic and infected emboli are often carried to the terminal arteries of the cortex and give rise to infarcts either anemic or septic according to the character of the embolus. Septic emboli may also be carried directly to the perirenal fat by the branches of the main renal artery before it enters the kidney.

Veins. These arise from the capillary networks of the cortex and pyramid, forming at the base of the latter larger trunks from which the veins are formed which enter the renal sinus and emerge at the hilum to form the main renal veins. The number of these in front and behind the pelvis correspond closely to those of the arteries but as in the case of the latter anomalies may be

FIG. 29



FIG. 30

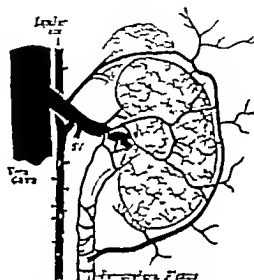


FIG. 29—Specimen showing relations of renal pelvis as seen with area of portion of parenchyma of posterior half of kidney removed. Note division of pelvis proper into superior and inferior portions and how two major calices each of which ends in a corkscrew arrangement to receive the tips of the papillae. The main renal artery and vein are seen passing in front of the pelvis and a superior polar artery arises from the main renal. (See The Character on Anomalies and Diseases of the Blood Vessels of the Kidney.)

FIG. 30—Venous anastomoses of kidney and ureter. (After Albarran.) Note close relation between stellate veins on surface of kidney and those of the perinephric fat. Also note the relation of perirenal and perinephric veins. Of great interest from an operative standpoint is the lumbar vein which receives many branches from the perinephric venous plexus and may be injured during operation.

present which are of importance in pyelotomy. Accessory or supernumerary i.e. polar veins often accompany similar anomalous polar arteries.

The anastomoses of the renal vein (Fig. 30) with those of the adrenal perirenal fat diaphragmatic retroperitoneal (lumbar) spermatic and those around the uterus are very numerous so that when the renal vein is blocked there is abundant collateral circulation. The vein, as well as the arteries form a network around the calices so that they can be easily torn during delivery of a calculus from a major minor calyx.

Lymphatics. The lymphatics form a network in the cortex and medulla surrounding the tubules and blood vessels. Those of the cortex communicate with a similar network beneath the fibrous capsule and these in turn with the lymphatics of the perirenal fat so that it is easy for infection to travel from the kidney to its envelope. (Fig. 31.) The capillary lymphatics of the parenchyma unite to form first a series of larger trunks which accompany the blood vessels.

the renal sinus emerging at the hilum to end in the lymph nodes around the aorta and vena cava (Fig 31) They also communicate with the lymphatics of the

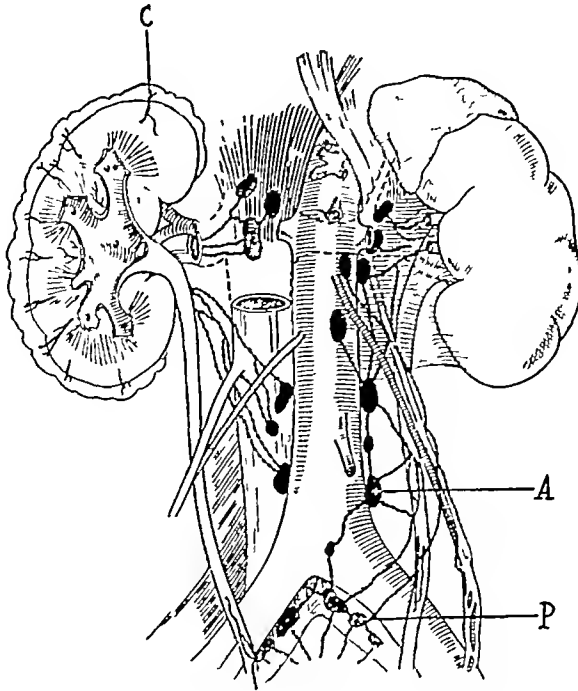


FIG 31—Lymphatics of kidney C indicates intimate relations between the lymphatics of the cortex and those of perinephritic tissues Note how the main lymphatics of the kidney proper and perinephritic fat drain into lymph nodes lying along the renal pedicle From this point, lymphatic drainage can take place either in an upward direction towards the mediastinum and lungs or in a caudal direction towards the nodes along the aorta (A) and iliac vessels (P)

periuireteral sheath so that infection may spread to the kidney or perirenal fat from below epididymis, prostate, seminal vesicles, etc

INNERVATION OF THE KIDNEYS

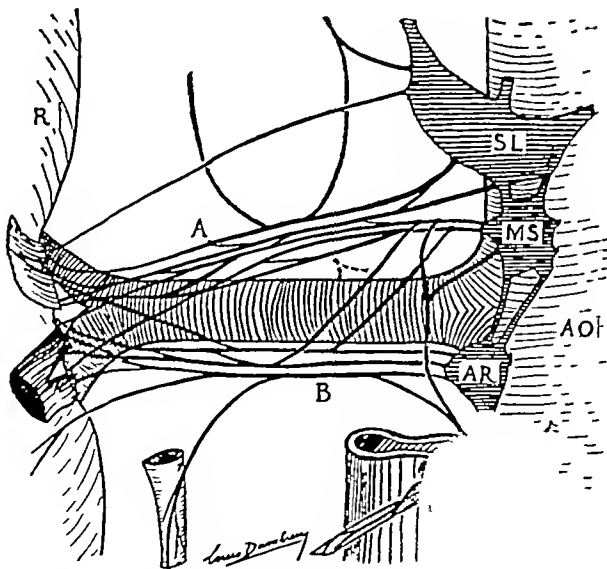


FIG 32—Innervation of the kidney (Dambrin), com of the nerves is from the semilunar (SL) superior mesenteric The periarterial plexus forms three groups around the superior (A) and inferior (B) most important

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ORIGIN OF THE NERVES (FIG 32)

1 **Principal Origin.** This is essentially from the solar plexus, composed of the semilunar superior mesenteric and aorticorenal ganglia. The branches which the solar plexus gives to the kidney are (a) periarterial and (b) direct, i.e. follow a course independent of the main renal artery.

2 **Secondary or Accessory Origin.** The kidney receives nerves from other sources which are less constant than those from the solar plexus. They arise from the major and minor splanchnic nerves, the inferior splanchnic nerve when present and from the vagus. Dambrin⁴ who dissected the nerve supply of the kidneys of 48 adult and foetal cadavers, was unable to find a branch from the vagus although this is described by Heitzmann.

There are also many anastomoses between the nerves of the kidney and those of the capsule.

Course of nerves from their origin to point of division of main renal artery (Fig 32)

In the space between the above principal and secondary origins and the renal sinus, the following are found:

1 A periarterial nerve plexus.

2 Fibers arising directly from the solar plexus and passing independently of the periarterial plexus (4 of Fig 32) to the hilus of the kidney and to the capsule.

3 Fibers from the adjacent large nerve trunks.

THE PERIARTERIAL PLEXUS Of most interest in connection with the operation of denervation or renal sympathectomy is the first of these, the periarterial plexus (Fig 32). This forms three distinct groups of nerves around the renal artery. If more than one main artery is present, these nerves are most constantly found surrounding the larger or largest vessel respectively.

SUPERIOR PERIARTERIAL NERVE GROUP This is composed of 7-8 fibers which lie about 8 mm. from the artery where it arises from the aorta, but are in intimate contact with the renal artery in its lateral (outer) half.

MIDDLE PERIARTERIAL NERVE GROUP The fibers on the anterior are much less constant than those along the posterior surface.

INFERIOR PERIARTERIAL NERVE GROUP This is formed by 4-5 fibers in intimate contact with the lower border of the main renal artery (B of Fig 32).

Fibers Direct to the Kidney from Solar Plexus These fibers, only 4-5 in number, follow an independent course (from that of the superior periarterial nerve group described above) between the solar plexus and the hilus or capsule of the kidney.

Fibers Direct to the Kidney from Adjacent Nerve Trunks. The major splanchnic occasionally sends fibers directly to the renal hilus. The inferior splanchnic nerve furnishes few direct fibers. When this nerve is absent, the minor splanchnic sends fibers to the superior periarterial plexus.

Course of nerves from point of division of renal artery to their entrance into hilus. In this portion of their course there is an absence of any regular arrangement of the fibers (Fig 33), the nerves being found on any area of the

Louis Dambrin. The nerves of the kidney and its capsule. Monograph published by Cleder, Toulouse, France, 1932 and also article in Arch. Mal. Reins, 1932, 3: 7-427.

circumference of the arteries. The veins are not accompanied by any nerve fibers.

Mode of Penetration of Nerves Into Parenchyma The nerves, like the arteries, enter the parenchyma of the kidney by orifices around the papillae of the malpighian pyramids, after entering the hilus. In addition, the kidney tissue receives some nerve branches from its capsule (renocapsular anastomoses). Nerve fibrillae can be found in the walls of the blood vessels which can be followed to the interlobar arteries (Fig. 33). Nerve ganglia exist in the pelvis and calices which latter are richly supplied with nerves. The same is true of the peritoneum overlying the kidney. It appears probable, according to Dambrin, that the nerves of the capsule form a network around the convoluted tubules, Henle's loop and

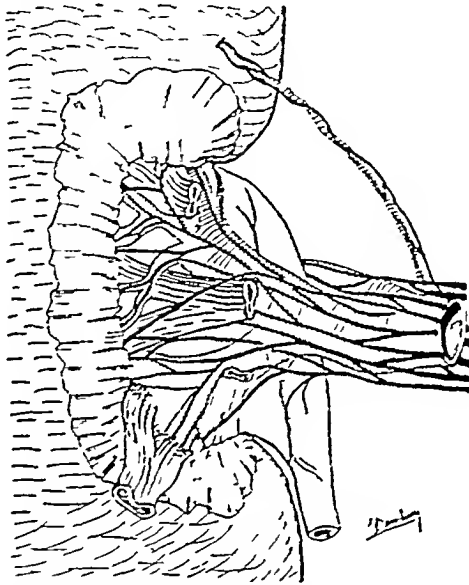


FIG. 33—Innervation of the kidney (Dambrin). Note the absence of any regular arrangement of the nerves after their entrance into the hilus as seen in this drawing with the anterior lip of the parenchyma removed.

the beginning of the collecting tubules, whereas the nerves entering the hilus innervate the vessels and pyramids.

THE URETER

The ureter is a flattened tube which begins at the outlet (usually 7 cm below renal hilum) of the renal pelvis and ends at an orifice, the ureteral, at one angle of the vesical trigone. The length of the ureter as given by various anatomists varies from 28 to 34 cm, the right ureter being 1 cm shorter than the left.

DIVISIONS From the anatomic standpoint it is customary to divide the ureter into an abdominal and a pelvic portion. The former (13-14 cm long—about 5.5 inches) begins at the junction of the ureter and renal pelvis (frequently referred to clinically as the ureteropelvic junction) and ends at the point where the ureter crosses the iliac vessels (Fig. 34). The pelvic portion extends from this point of crossing, to the ureteral orifice on the floor of the bladder.

Clinically we divide the ureter into three portions (Fig 34)

(a) The lumbar portion (from ureteropelvic junction to crest of ilium)

(b) The iliac portion (from crest of ilium to iliac vessels)

(c) The pelvic portion (12-13 cm. long) from iliac vessels to point of entrance into the bladder. The term juxtavesical is applied to the last 2.5-3 cm. of the pelvic portion

(d) The intramural (This is 2-3 cm long)

FIG. 35

FIG. 34

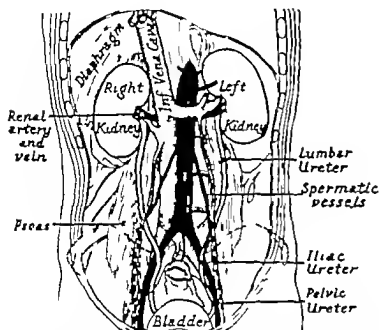
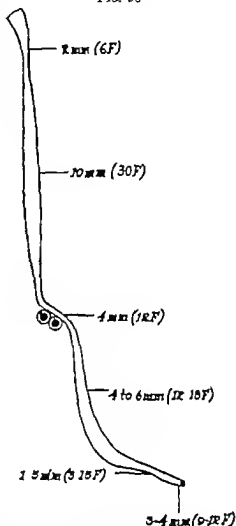


FIG. 34—Topographical relations of the kidneys and ureters and also blood vessels of the kidneys (After Albarran)

FIG. 35—Sectional view of ureter showing variations in caliber of its different portions. The figures in parenthesis indicate the size bougie or bulb which can be normally admitted



Variations in Caliber of Lumen. There are as a rule three points of narrowing and two enlargements of the ureteral lumen. These are shown in Fig 35

Location	Diameter	Size Catheter or Bougie
Ureteropelvic junction	2 mm	6 French
Lumbar spindle	10 mm	30 French
At iliac crossing	4 mm	12 French
Pelvic spindle	4-6 mm.	12 to 15 French
Juxtavesical	1-5 mm.	3 to 5 French
Intramural	3-4 mm.	9 to 12 French

RELATIONS OF ABDOMINAL (LUMBAR AND ILIAC) PORTION

(a) **To the Abdominal Wall (Fig 15)** Projected on the anterior abdominal wall the course of the ureter corresponds to a line drawn upwards vertically from the junction of the inner and middle thirds of Poupart's ligament

(b) **To the Deeper Structures.** The ureter in its lumbar and iliac portions (pars abdominalis) lies in contact with the aponeurosis of the psoas muscle

about a finger's breadth from the spine. In front, lies the posterior peritoneum and so intimate is the relation here, that it is usually very difficult to identify the ureter in the subserous fat. The wide range of mobility of the ureter in its abdominal portion is important to bear in mind clinically. About midway in their course to the pelvis, both ureters are crossed in front, at a very acute angle (Fig. 34) by the spermatic (or ovarian) vessels and behind and obliquely by the genitocrural nerve. The right ureter passes behind the descending portion of the duodenum above and behind the terminal ileum and vermiform appendix below.⁵



FIG. 36—Sagittal section showing mode of crossing of the ureter by the intraabdominal portion of the vas deferens (After Corning)

At the pelvic brim, the ureters cross the iliac vessels obliquely approximately where the artery divides into its internal and external divisions (Fig. 31). On the right side, the ureter may pass across the external iliac vessels instead.

THE PELVIC PORTION OF THE URETER

(a) *In the Male* It lies deeply imbedded in the subserous tissue of the lateral wall of the pelvis, curving downward and forward to about the level of the ischial spine where it turns inward to reach the posterior wall of the bladder. It is crossed on its inner side by the vas deferens and pierces the bladder wall immediately in front or under cover of the upper end of the seminal vesicle.

⁵ Up to 1936, fourteen cases have been reported of postcaval ureter, i.e. the ureter in its lumbar portion, passed behind the inferior vena in its course downwards. These cases will be described in the Chapter on Anomalies of the Ureter.

(Figs. 36 and 37) We will refer later to the importance of this relation of the ureter and seminal vesicle. It is not difficult to visualize how infection may spread from the seminal vesicle to the ureter

The ureter in its last 18 mm ($\frac{3}{4}$ inch) passes obliquely from without inwards through the vesical wall, to end in the ureteral orifice

(b) In the Female (Fig 38) Here the ureter (after reaching the lateral wall of the pelvis) descends in close proximity to the unattached border of the ovary. On the pelvic floor, it enters the base of the broad ligament, crossing the uterine artery (Fig 41) and continues downward and mesially in the vicinity of the cervix, to the vagina. Its terminal segment lies imbedded in the connective tissue between the bladder and vagina close to the anterior vaginal wall from which point it bends sharply inward to penetrate the vesical wall obliquely

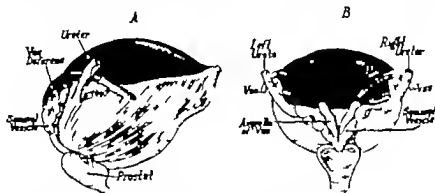


FIG 37—Lateral view of bladder (after Corning) showing in black, the extent to which the peritoneum covers the bladder and also the relations of the ureter to the seminal vesicles and vas deferens.

B View of bladder from behind showing how the ureters are crossed on their ventral surface by the vasa deferentia and also the intimate relation between the seminal vesicle and the ureter

STRUCTURE OF THE URETER

There are three coats, the outer fibrous, the middle muscular and an inner epithelial. Between the two last named, is loose areolar tissue forming a submucous layer in which there are many blood vessels and lymphatics. The areolar tissue around the outer or fibrous coat also contains many vessels and lymphatics and is continuous above (Fig 17) with the fat around the kidney and below with the connective tissue surrounding the internal genitalia in both sexes. The epithelial lining is continuous with that of the pelvis and bladder, being made up of the same transitional epithelium, so that one can no longer say that epithelial cells found in the urine come from any specific portion of the urinary tract. At the lower end of the ureter there is an additional muscular coat the sheath of Waldeyer, composed of thick bundles of longitudinal muscle fibers which surround the intramural portion of the ureter and separate it from the musculature of the bladder

VASCULAR AND LYMPHATIC SUPPLY OF THE URETER

Blood Vessels. The ureter in its upper portion receives branches from the renal artery and vein. Where the spermatic artery crosses, it also gives off a small branch to the ureter. The pelvic portion is supplied by the superior vesical and internal iliac arteries in the male and the uterine and inferior vesical in the female. Both the arteries and veins form a network around the ureter.

Lymphatics. There are two sets of lymphatics, (a) those in the ureteral wall itself and (b) those of the periaureteral sheath. The former lie chiefly be

tween the epithelial lining and muscular coats and the latter lie in the fibrous outer coat. Both of these sets of lymphatic capillaries communicate in a longitudinal direction with those of the kidney and bladder and segmentally, i.e. horizontally, with the lumbar and pelvic lymph nodes. There is a free communication between the lymphatics of the broad ligament in the female and structures around the base of the bladder in the male (prostate and seminal vesicles), with the

FIG 38

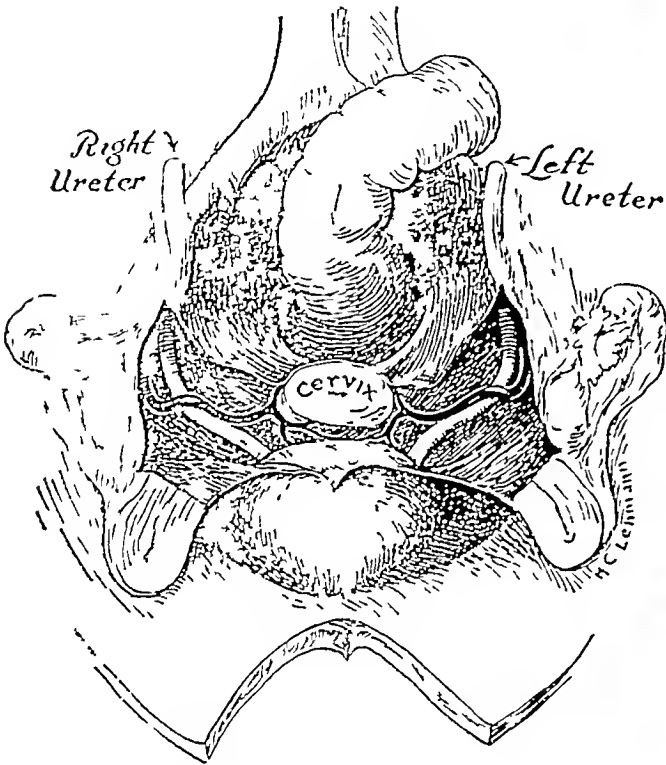


FIG 39

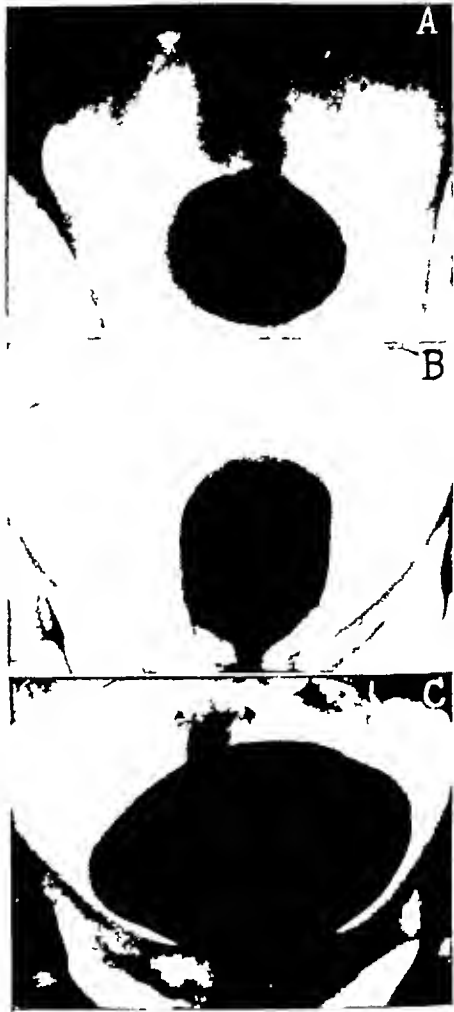


FIG 38—Relation of ureters to cervix and uterine arteries (After Corning) Note how pelvic portion of ureter lies within folds of broad ligament and also note proximity of ureter to cervix close to point of entrance of ureters into bladder
FIG 39—Cystograms of normal adult bladders
A Almost spherical form
B Marked increase in longitudinal axis
C Typical ovoid form, most common

lymphatics of the ureter, especially those of the periureteral sheath
Nerves The ureter receives innervation in its upper part from the renal plexus, in its middle and lower portions from the upper sacral ganglion and from the inferior hypogastric and vesical plexus. These fibers anastomose freely so that there is continuous transmission of impulses from the vesical to the renal plexus, i.e. from the bladder to the kidney and in an opposite direction

THE BLADDER

The bladder is a hollow organ whose wall is made up chiefly of muscle, acting as a unit in exerting pressure from all sides on the contents so as to force

them toward the internal meatus. We speak clinically (see Chapter 7 on Cystoscopy and Ureteral Catheterization) of an anterior, a posterior and two lateral walls as well as of a vertex and base. The shape of the empty bladder is pyriform but when distended its form changes according to the degree of filling. This is best studied in cystograms and exposures in both anteroposterior (axial) and semilateral (three quarters) positions. These show that there is a great variation not only in the form but also in its capacity at least in adults. Some normal bladders (A of Fig 39) will hold only 150 cc. of fluid and have an almost round form others (B of Fig 39) will hold a little more but have a more elongated form (in the anteroposterior axis of the pelvis) while still others will have a capacity of 250-300 cc. and a more ovoid form (C of Fig 39) both in anteroposterior and lateral views. When filled to its normal capacity, the smaller types

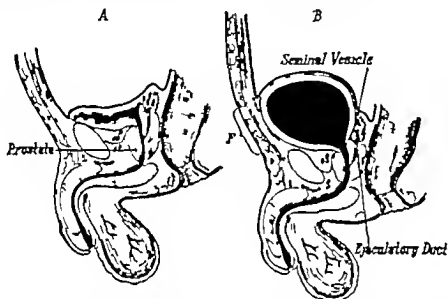


FIG. 40.—A. Sagittal section showing peritoneal reflection in close contact with upper border of pubis when bladder is empty.

B Same when bladder is filled showing how peritoneal reflection from anterior abdominal wall to bladder is displaced upward so that the space indicated by the letter F lies extraperitoneal and through it the anterior wall of the bladder can be opened extraperitoneally.

of normal bladder (in adults) will rise but little if any above the pubes while those which have normally a greater capacity (250-300 cc.) will rise above the pubes and push upwards the fold of peritoneum which covers the superior surface of the bladder but is loosely attached to the pubes (Fig 40). These anatomic variations in the form and capacity of the normal adult bladder are of much importance in such operations as suprapubic cystostomy. In children, the bladder lies much higher in the pelvis than in later life. In women on the other hand the bladder lies lower than in men.

MUSCULATURE OF THE BLADDER

The musculature of the bladder may be divided into two parts (a) That of the entire wall except the trigone (b) that of the trigone (c) that of the vesical neck.

(a) *The Entire Wall Except the Trigone* The bladder is lined by a transitional epithelium which is continuous with that of the ureter and of the urethra. The wall aside from this epithelial lining is made up chiefly of muscle fibers arranged into an outer longitudinal middle circular and an inner oblique

layer. Because of these acting together on the bladder contents (see above) it is better to consider them as one muscle, the "detrusor" of the bladder. Between the musculature and the epithelial lining (mucosa) is loose cellular tissue, which is only absent over the trigone. The latter (Fig. 41) is an area at the base of the bladder which has the form of an equilateral triangle whose angles are formed by the two ureteral orifices or meati and by the internal urethral orifice. Over the trigone the epithelial lining of the bladder is firmly attached to the underlying muscle while in all other portions of the cavity the epithelial lining (mucosa) is so

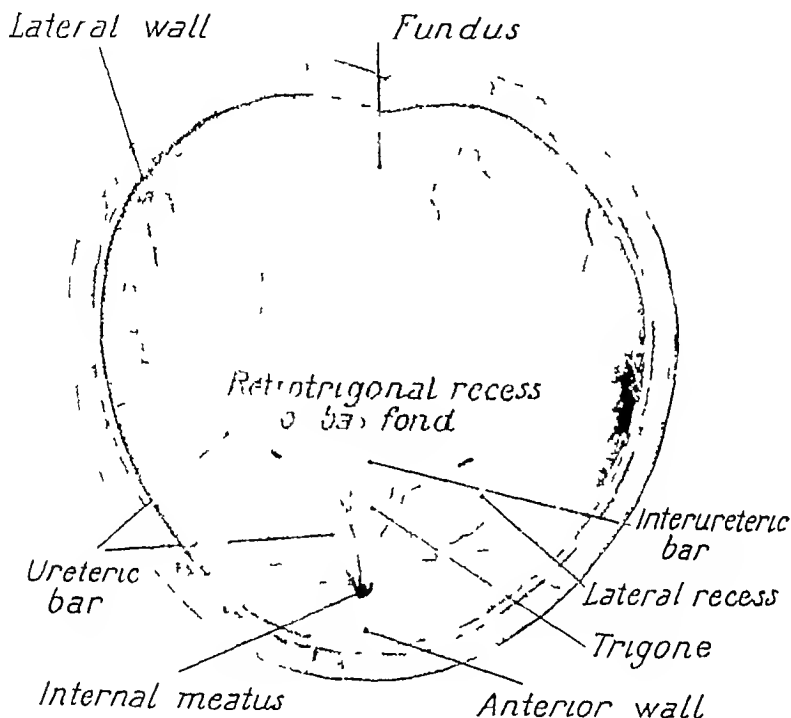


FIG. 41—View of trigone and posterior wall of the normal bladder (After Knorr)

loosely attached to the detrusor (through the medium of the submucous layer) that when the organ is empty, the epithelial lining is arranged in folds.⁶

(b) The musculature of the trigone. We are indebted to Wesson⁷ for a better conception of the trigonal muscle. This develops in the embryo from the muscle layers surrounding the lower ends of the wolffian ducts and ureters. Later in fetal life, these muscles come to lie in the bladder and their main bundles run from the ureteral orifices to the vesical orifice, where the bundles from the two sides join and run down, just beneath the urethral mucosa on the posterior aspect, to and beyond the verumontanum. The upper margin of these bundles passes across from one ureteral orifice to the other, forming a slight elevation, the interureteral ridge (Mercier's interureteric bar) which is of great assistance in locating the symmetrically placed ureteral orifices.⁸ These are 2.5 cm. apart when the

⁶ It is difficult for the beginner in cystoscopy to appreciate the necessity of adequate distention of the bladder in order to avoid this folding up of the mucosa.

⁷ Jour. Urol. 1920, 4, 279.

⁸ This ridge forms the base of the equilateral triangle, the trigone, at the base of the bladder. If one finds the ridge the ureteric orifices are located at the respective lateral angles.

bladder is empty and 3.5 to 5 cm apart when it is filled. The ureteral orifices vary greatly in form; they may be slit like, oval, punctate or hidden beneath an overhanging fold of mucosa (See Chap. 6). The orifice is usually located on a slight elevation termed the ureteral papilla. Behind this interureteric ligament or ridge (Mercier bar) there is a shallow depression termed the retrotrigonal fossa or 'bas fond' by the French writers.

The vesical orifice forms the apex of the triangle or trigone and has a slight elevation known as Lieutaud's uvula which is continuous with a similar ridge on the posterior surface of the prostatic urethra and ends in the verumontanum.

A contribution of much clinical importance as to the trigonal muscle has recently been made by Young and Wesson. They have found that its contractions pull open the vesical orifice during the act of micturition and also that when there is an obstruction at this orifice, the trigonal muscle hypertrophies and the interureteric ridge forms the anterior wall of a pouch, so that there is residual urine in the retrotrigonal fossa just as in cases of prostatic hypertrophy. We will take this up later in the chapter on Vesical Neck Obstructions.

(c) *The musculature of the vesical orifice.* The term neck of the bladder is employed to designate the region around the vesical orifice. There is no distinct neck, although the bladder becomes narrower at this region. Here the division of the detrusor muscle into layers is more marked. From each of the two layers just posterior and lateral to the vesical orifice is sent a strong band of muscle fibers which runs down and forward to the prostate to form a loop around the front of the urethra. The

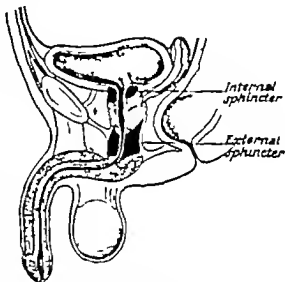


FIG. 42.—Diagrammatic representation of locations of internal and external sphincters. Note how latter surrounds membranous urethra. This must be kept in mind in perineal prostatectomy.

bundle from the external (longitudinal) layer is thicker than that of the internal (circular). These together form the "internal sphincter" which is not a circular muscle like the sphincter ani but only forms an arch around two-thirds of the vesical orifice. The external sphincter (Fig. 42) is a voluntary muscle while the "internal sphincter" being supplied by sympathetic and parasympathetic fibers, is an involuntary muscle.

RELATIONS AND FIXATION OF THE BLADDER

Peritoneal Covering. The bladder is covered by peritoneum which is loosely attached except over the vertex (Fig. 37) where it is firmly adherent over an area the size of a silver dollar. This peritoneal covering is reflected along the sides of the bladder to the floor of the pelvis and extends along the posterior wall in the male as far caudally as the upper end of the seminal vesicles and vasa deferentia, forming here the rectovesical pouch. Only in children does this fold extend down to the prostate. In the female, this peritoneal fold is reflected

only the first and second) paravertebral lumbar sympathetic ganglia (B of Fig 45) on each side. The presacral nerve lies retroperitoneally in front of the fifth lumbar vertebral body. After receiving the above two sets of fibers, it divides into the two hypogastric nerves which pass through the hypogastric ganglia (C of Fig 45) to reach the bladder. Relatively small bundles join the hypogastric ganglion, on each side, from the second and third sacral ganglia of the lateral sympathetic chains.

2. The Pelvic or Parasympathetic Pathway. These fibers arise from the anterior primary divisions of the second, third and fourth sacral nerves. These nerves (E of Fig 45) termed pelvic (Langley) or *nervi erigentes* (Eckhardt) also pass through the hypogastric ganglia (C of Fig 45).

The ultimate nerves to the bladder consist of eight to ten branches which leave the anterior border of each hypogastric ganglion. The two sets of fibers, i.e., from the sympathetic and parasympathetic pathways, are not separable after they have left the hypogastric ganglia.

As stated above, the nerve supply of the posterior urethra is of somatic origin. The nerves, termed pudic, arise (F of Fig 45) from the second, third and fourth sacral segments of the spinal cord and supply both afferent and efferent fibers to the posterior urethra.

The mode of action of the muscles supplied by the nerves of the bladder and posterior urethra will be considered in the section of Physiology of Micturition, in the next chapter.

THE URETHRA

DIVISIONS. From the anatomic standpoint, the urethra is divided into a prostatic, a membranous and a penile portion. Clinically we employ the terms anterior and posterior urethra. The latter includes the prostatic and membranous portions, while the anterior includes the rest. The anterior (superficial or inferior) layer of the triangular ligament thus separates these two portions.

Length and caliber of the various portions of the male urethra (Fig 46). In order to conform with our methods of examination of the caliber, etc. of the urethra we will begin with the anterior portion.

Anterior (Pendulous, Penile, Spongy) Urethra. This has an average length of 14 cm (5.5 in.).

CALIBER OF VARIOUS PORTIONS OF URETHRA

1. At the meatus (external)	admits 21 to 28 F Sound
2. At the fossa navicularis	30 to 33 F "
3. Middle of penile portion	27 to 30 F "
4. At the bulb	33 to 36 F "
5. At membranous portion	27 F "
6. Prostatic portion	45 F "

Posterior Urethra. (a) Membranous portion, average length 1.5 to 2.5 cm. (b) Prostatic portion, average length 2 to 3 cm.

Curve of the urethra. The urethra describes two curves: (a) a posterior with its concavity directed upward and forward (anteriorly) and (b) an anterior curve directed downward and backward. The first is a permanent curve but

the second changes when the penis is raised as during the passage of an instrument so that the anterior and posterior curves become continuous.

Special characteristics of different portions of the urethra The prostatic portion This extends from the internal urethral orifice to the posterior layer of the triangular ligament. It penetrates the prostate from its base to its apex. On its floor is an elevation, the urethral crest with the verumontanum (colliculus seminalis) at its middle. Into the veru open the utricle (remnants of fusion of müllerian ducts) and the ejaculatory ducts. In the depressions on each side of the urethral crest are the openings of the prostatic glands (Fig 47). At the apex of the prostate, the urethra is encircled by bundles of striped muscle.

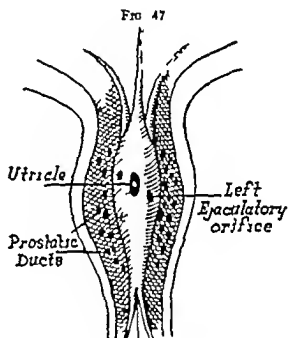
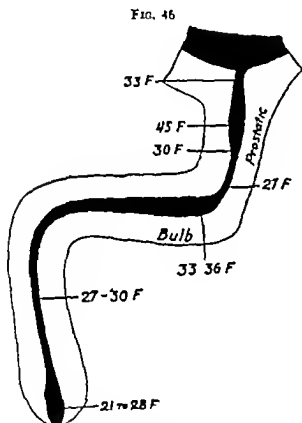


FIG. 46.—Sagittal section of human urethra showing variations in caliber of its three principal portions. The figures indicate the caliber of sound which the respective portions, will permit the passage of.

FIG. 47.—View of veru montanum (after Papin) showing location of utricle in midline and relation to it of the ejaculatory duct orifices lying along the lateral surfaces of the veru. In the gutter or groove on either side of the veru are the openings of the prostatic duct.

The Membranous Portion (Fig 48) This is the most fixed and least dilatable portion of the urethra. It pierces both layers of the triangular ligament extending from the apex of the prostate to the bulb being surrounded throughout its length by the fibers of the compressor urethrae.

The membranous urethra is usually devoid of glands. Infections arising from this portion of the urethra are prevented from passing anteriorly because of the attachment of Colles fascia to the triangular ligament (Fig 48) hence extravasation of urine and similar peri urethral infections are led backwards.

These curves are of importance to remember in relation to those to which metallic urethral instruments (sounds, catheters, etc.) must conform.

by the triangular ligament to its rectal edge and thus to the ischiorectal fossae where they usually appear when they come to the surface

The Spongy (Penile, Pendulous, Cavernous) Portion This presents at its beginning, a fusiform dilatation known as the bulb (often referred to as the bulbous portion) It narrows abruptly where it passes into the membranous urethra and is about 2 cm long The walls of the bulb are relatively thin and the lumen being wider than elsewhere in the anterior urethra, care must be exercised lest a metallic instrument impinge too firmly against the walls and give rise to a false passage (See Chapter V on Minor Technic) The ducts of Cowper's glands (which lie between the layers of the triangular ligament) open into the bulb (See Fig 9)

In the remainder of the spongy or anterior urethra, one finds two structures of much clinical interest These are the glands of Littre and the lacunae or crypts of Morgagni The latter are found chiefly along the upper wall and are really only tubular depressions which often receive glands The glands of Littre embrace two groups, those within the mucous membrane and those within the submucous tissue The former are more numerous and more widely distributed The submucous occur most frequently on the upper wall of the anterior urethra

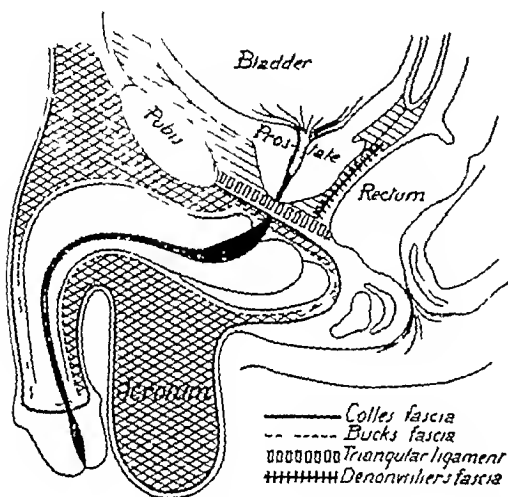


FIG 48—Diagrammatic representation of extravasation of urine areas in rupture (from trauma or as complication of stricture) of urethra The extension in front of the triangular ligament is shown in the form of interlacing lines forming squares while that behind the triangular ligament is shown in straight lines (see text) (Modified after Wesson)

PELVIC AND PERINEAL FASCIÆ AND MUSCLES

We will only consider those which are of urologic interest As Wesson has pointed out, the urologist employs surgical terms (Denonvilliers' fascia, rectourethralis muscle, Buck's fascia and Colles' fascia) to designate conveniently

certain anatomic landmarks which to the anatomist are not definite structures (Figs 48, 49, 55 and 59)

The pelvic fascia¹⁰ is attached to the iliopectineal line (Fig 59) and after covering the upper portion of the obturator internus muscle, divides at the "white line" (a thickening of the fascia) into three layers

- (a) The obturator fascia—covering the rest of the obturator internus
- (b) The anal fascia—a covering for the under surface of the levator ani muscle
- (c) The rectovesical fascia¹⁰ which covers the upper surface of the levator ani muscle

The Pelvic Diaphragm The floor of the pelvis is formed by two muscles which constitute an almost complete partition, the pelvic diaphragm The larger and more anterior is the levator ani, a portion of those fibers pass downwards to reach the sides of the rectum Between these fibers and those of the corresponding portion of the muscle of the opposite side is a space occupied in the

¹⁰ Piersol and many German anatomists apply the term pelvic fascia to this structure

male by the lower part of the prostate, and in the female, by the base of the bladder and lower part of the vagina

The Perineal Muscles.¹¹ Those of urologic interest are the following

(a) The transversus perinaei superficialis muscles. A band of fibers which arise from the medial surface of each ischial tuberosity and are inserted into the central tendon of the perineum (Fig. 49)

(b) The ischiocavernosus (erector penis) muscles which arise from the base of the tuberosity of the ischium enclosing the base of the crus penis as in a sheath. They compress the corpus cavernosum and thus assist in producing or maintaining erection of the penis.

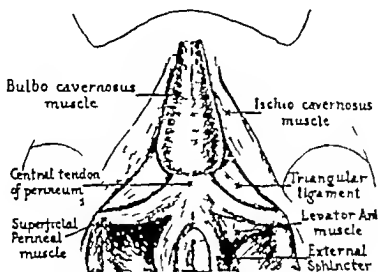


FIG. 49—The superficial muscles of the male perineum (After Pieroni)

(c) The bulbocavernosus in the male arises from the central tendon of the perineum then surrounds the bulbous portion of the urethra and ends in the inferior layer of the triangular ligament. It compresses the bulb and corpus spongiosum and so expels any fluid in the urethra.

(d) The transversus perinaei profundus muscle. This lies in the posterior part of the deep perineal interspace and assists in fixing the central tendon of the perineum.

(e) The compressor urethrae (external sphincter). This arises from the inner surface of the inferior ramus of the pubis and surrounds (Fig. 42) the membranous urethra acting to constrict its lumen.

The Perineal Fasciae. The urogenital trigone (trigonum urogenitale) usually called the triangular ligament of the perineum is formed by the deep fascia of the perineum and is composed of two layers: the superior or proximal and inferior or distal. It fills the space between the rami of the pubes and a part of those of the ischia. Between the two layers there is a space in which are to be found the membranous urethra, the glands of Cowper, the pubic vessels and nerves and anteriorly the subpubic or arcuate ligament. The dorsal vein of the penis passes between this and the fused anterior borders (transverse pelvic ligament) of the triangular ligament. Above the triangular ligament fuses with the fascia covering the prostate laterally it fuses with the fascia covering the levator ani, behind, with fascia of Denonvilliers and to the posterior

¹¹ The topography of the male perineum will be considered in connection with the perineal prostatectomy.

border of the distal layer is attached Colles' fascia (deeper layer of the superficial perineal)

The pelvic fasciae as well as the triangular ligament are of much clinical interest in connection with urinary extravasation as Wesson has shown¹²

The Superficial Perineal Fascia (Fig 48) This is composed of two layers, the more superficial is really the panniculus adiposus of the skin The deeper layer was first described by Colles¹³ and bears his name This is attached at the sides to the ramī of the pubes and ischia and in front becomes continuous with the dartos of the scrotum and on either side of this with the corresponding layer of the anterior abdominal wall Behind it unites with the posterior border of the external (inferior) triangular ligament (Fig 48) and then passes over into the superficial fascia of the gluteal region By the union of this Colles' fascia (deep layer of superficial fascia) with the triangular ligament behind

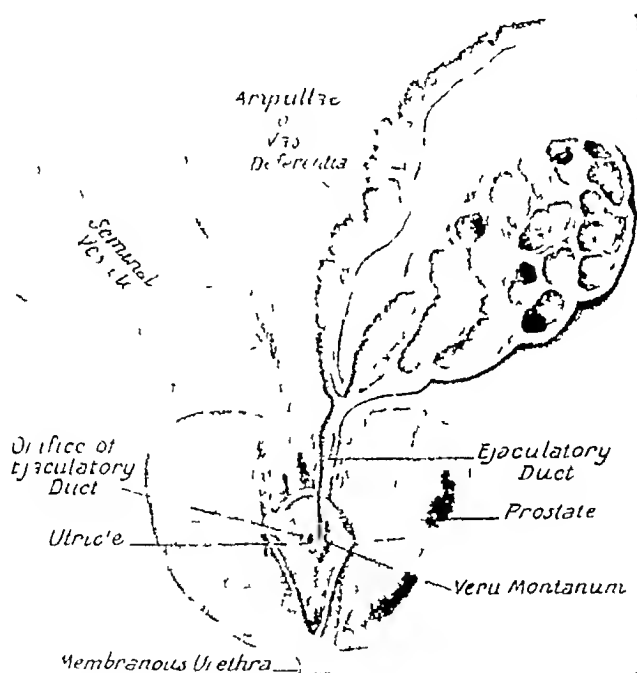


FIG 50—Mode of ending of the ampulla of the vas deferens in the neck of the seminal vesicle Note how the ejaculatory duct is a direct continuation of the seminal vesicles (After Toldt)

(Fig 48), a space is formed, termed the superficial or anterior perineal which is only open anteriorly where it communicates with the superficial and deep layers of the abdominal fasciae This space contains the bulb and spongy portions of the urethra so that urinary extravasation arising from these portions will first invade the perineum and scrotum and later the anterior abdominal wall, rarely involving the thighs Extension down the penis is opposed by the close application of Colles' fascia to the deeper fasciae of the penis proper, at its root, so that the fluid can only extend up into the abdomen

Denonvillier's fascia is the term applied by urologists to the sheath between the prostate and rectum It has two layers, of which the anterior covering the prostate is the thicker At the apex of the prostate the fascia is continuous

¹² Wesson, Miley B Jour A.M.A., 81, 2024, Dec 15, 1923

¹³ Colles A Treatise on Surgical Anatomy, Dublin, 1811

with the superior layer of the urogenital triangle Wesson does not agree with the theory that this fascia is formed by the fusion of two layers of fetal peritoneum (See Fig 3)

THE PENIS

There are two portions viz. an anterior or free which forms the visible part and a posterior or perineal which is buried beneath the skin and fasciae of the perineum. The entire organ has a posterior extremity or root a body proper an anterior or distal extremity (glans), a superior surface (dorsum) two lateral borders and an inferior surface. Of chief interest in connection with the root is the suspensory ligament (Fig 51) which flexes the penis to the symphysis pubis and anterior abdominal wall.

The glans penis (Fig 52) is an

FIG. 51

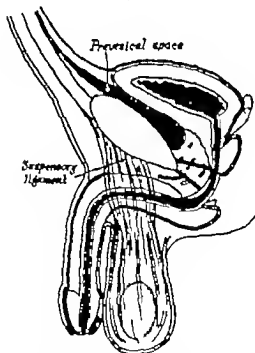
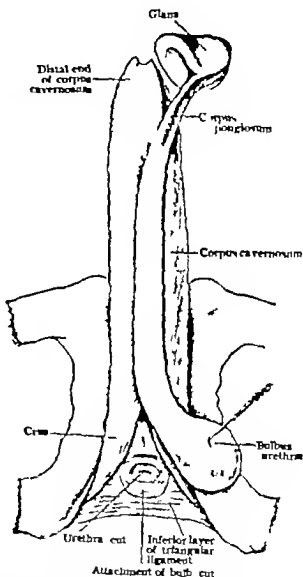


FIG. 51—Sagittal view of male pelvis to show suspensory ligament and space of Retzius (prevesical). The latter has been slightly exaggerated in order to show its relation to the pubis, bladder and anterior abdominal wall. (After Textut)

FIG. 52—Dissection of penis, showing three component cylinders of erectile tissue: distal end of corpus spongiosum with glans, has been freed and turned aside; attachment of urethral bulb has been cut and bulb drawn aside. (Piersol.)

FIG. 52



expanded portion of the corpus spongiosum and is hollowed out (Fig 52) to receive the pointed ends of the corpora cavernosa. It is conical in shape, and shows a projecting edge the corona, behind which there is a groove the sulcus. In the latter is inserted a triangular fold the frenulum. The glans is covered by

In addition to being penetrated in a curved manner by the prostatic urethra it also is traversed by the ejaculatory ducts (one on each side of the midline) from their point of origin to their termination in the veru montanum. It has the form of a chestnut, its base being in intimate relation to the vesical neck.

Its apex or distal portion is directed almost vertically downwards, marking the point of division between the prostatic and membranous portions of the urethra and rests against the superior (proximal or upper) layer of the urogenital diaphragm (triangular ligament).

The urethra (prostatic) penetrates the prostate from the middle of the base to a point just proximal to the apex forming a curve with its concavity directed anteriorly. The result is that the greater portion of the prostate lies behind and lateral to the urethra.

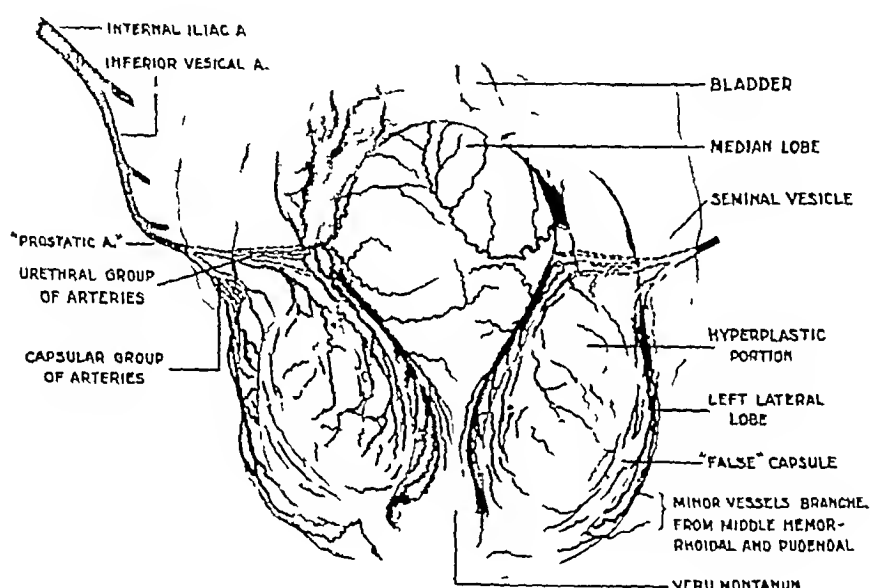


FIG 56—Distribution of arteries within the prostate gland (Courtesy of Dr R H Flocks)

The glands of the prostate develop in five groups in the embryo (Lowsley). The two lateral ones grow in length and complexity until they make up most of the gland. The posterior, anterior and median groups develop but little.

In addition to the prostate, there are two groups of rudimentary glands which are of great clinical importance, the small group beneath the neck of the bladder, named by Albarran, the subcervical lobe, and the group beneath the trigone, named by Home, the trigonal lobe. Loeschke, Adrion and Jacoby distinguish three varieties of glands in the adult prostate: (a) short and simple mucosal which arise principally on the lateral and anterior walls of the urethra at the veru montanum but are also found on the posterior wall near the sphincter; (b) Submucosal, longer and more branched glands running in an antero-posterior direction on each side of the urethra; (c) Prostatic glands proper which lie external to the mucosal and submucosal.

Albarran in 1902 found that the hypertrophied median lobe was derived from the inner submucosal central or periurethral glands, located at the posterior edge of the vesical orifice. Motz and Perineau later showed that the majority

of prostatic hypertrophies¹⁴ arise from these mucosal or suburethral glands, although some may begin in the prostatic glands proper

Except over its base, apex, and lower anterior surface, the prostate is enclosed by a fibrous capsule which is most dense where the prostate is in contact with the rectum. This portion of the capsule is termed the rectovesical septum or fascia of Denonvilliers (Fig 48) which also covers the posterior surfaces of the ampullae of the spermatic ducts and the seminal vesicles with which the prostate is in close relation. This fascia is of much importance in connection with operations on these structures.

On rectal examination (see Chapter 5) one can palpate the two lateral lobes with a median groove between them. The two ejaculatory ducts run almost par-

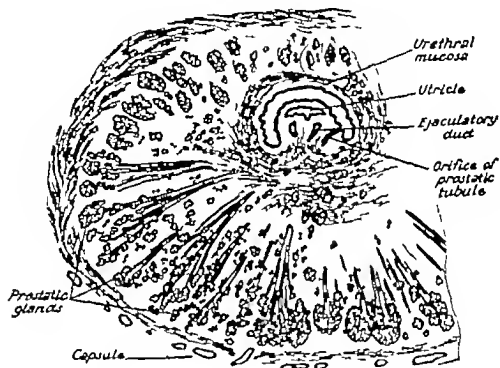


FIG 57—Cross section of normal adult prostate (after Todd) to show how ducts of prostatic acini radiate from urethra

allel through the prostate to open anterolateral to the utricle (Fig 57) in the majority of cases (McCarthy)

Since the membranous urethra is short and usually devoid of glands infection commonly takes the form of prostatitis or of prostatic abscess. Such infections after penetrating the capsule are usually led backward by the triangular ligament to its rectal edge and thus to the ischio-rectal fossae where they come to the surface. In an upward direction, infection extends to the pre- and perivesical spaces and to the cellular tissue around the rectum.

Vascular Supply The prostate is supplied by branches of the inferior vesical middle hemorrhoidal and internal pudic arteries. Of these the first named is the most important passing along the upper surface of the gland as the prostatic artery. The distribution of the arteries within the gland has been recently studied by R. H. Flocks (Jour Urol 1937 37 524). He found that there are two groups of arteries within the prostate—an external capsular group which shows little change with age and with the occurrence of hyper-

plasia, and an internal group, the urethral group, which enlarges significantly with age and very markedly with hyperplasia. This urethral group is very important in the consideration of transurethral prostatic resection and local repair following this operation for two reasons: (1) its anatomical arrangement—the urethral group of arteries penetrates at the prostatovesical junction and then turns distally in a course more or less parallel to the urethral surface, and (2) its ultimate destination—this group of arteries forms the main source of blood supply to the hypertrophied portion of the prostate.

FIG 58

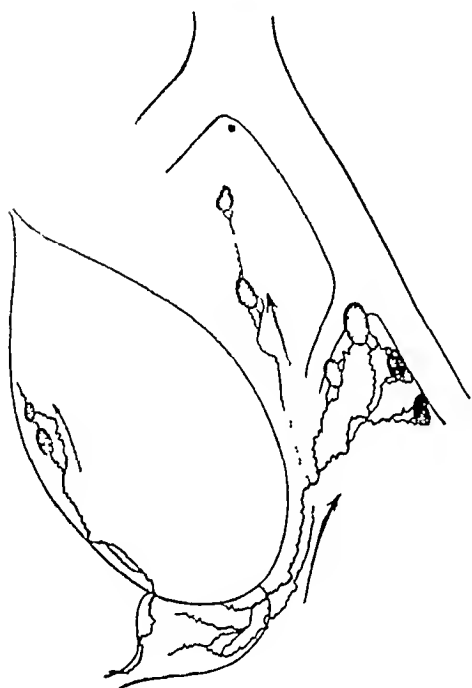


FIG 59

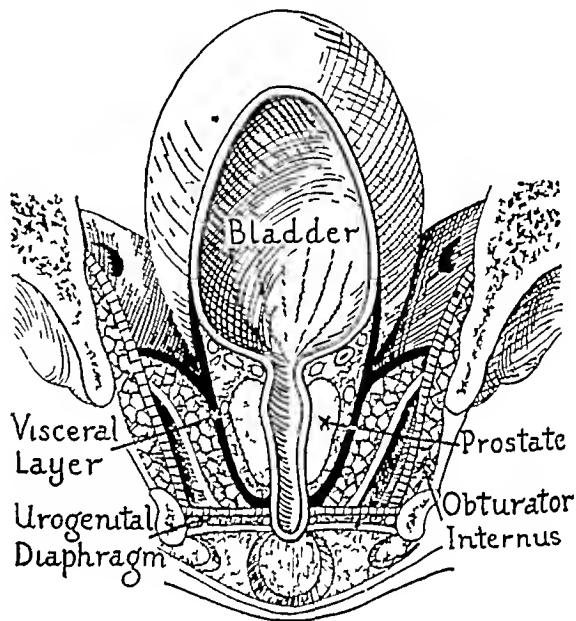


FIG 58—Lymphatics of prostate. The principal mode of drainage is towards the iliac nodes lying along the internal iliac vessels and towards the sacrum. A less frequent direction is towards the inguinal nodes, as shown by arrow along anterior wall of bladder.

FIG 59—Coronal section of male pelvis (after Corning) to show relations of the pelvic fasciae to bladder and prostate. (See text.)

The veins form a network within the capsule, which, after receiving the deep dorsal veins of the penis and communicating with trunks from the bladder, seminal vesicles and rectum, is continued as the vesicoprostatic plexus (Fig 43) which is tributary to the internal iliac veins.

Lymphatics These follow three routes (Fig 58) (a) along the seminal duct (vas) to the iliac lymph nodes, (b) to the hypogastric nodes and (c) to the anterior aspect of the sacrum and from here to the lowermost lumbar nodes.

Nerves These are chiefly sympathetic fibers derived from the hypogastric plexus.

THE SCROTUM

The scrotum is a wide loose bag, formed by the external skin and encloses the testicles, epididymes, spermatic cords and sheaths. Its integument is con-

tinuous above with that of the penis and behind with the perineum, laterally with the thigh. It is thin, of dark color wrinkled and possesses many sebaceous and sweat glands. In the subcutaneous tissues is the dartos muscle a network of smooth muscle fibers. This is connected above with the fascia of the penis and below with the perineum. The scrotum has a median raphe and its fascia forms a septum in the midline separating the scrotal sacs.

THE TESTES

The testes are two flattened ovoid bodies contained within the scrotal sac. The testis presents on its convex surface a bluish white appearance and its long axis is directed slightly upward and forward. There is an upper and lower pole (Fig 60) and an interior and posterior surface.

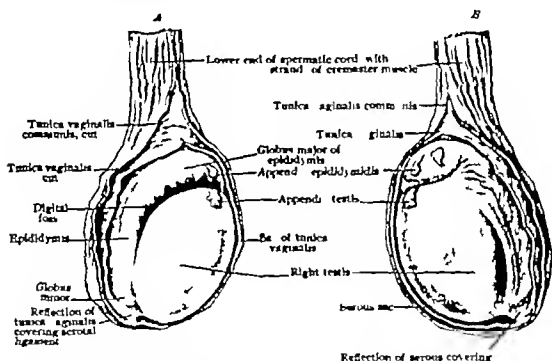


FIG 60—A Antero-lateral view of right testicle after enveloping membranes have been cut and turned aside B Antero-medial view of same (Piersol)

The tunica vaginalis derived from an invagination of the peritoneum over the organ in its descent covers the entire testicle and also epididymis except the head and tail.

Tunica Propria. The intimate covering of the testicle is the tunica propria or visceral layer of the tunica vaginalis. There is a space between the visceral and parietal layer produced by the descent of the testicle in which it has some mobility and is lubricated by the secretion of the endothelium of the tunica.

The tunica albuginea, (Fig 61) a tough membrane of connective tissue completely ensheaths the substance of testicle and is directly beneath the tunica vaginalis at its posterior margin it is thickened and extends here into the substance of the testicle. This is the mediastinum testis. Below this tunica is a network of blood vessels often termed the tunica vasculosa.

Septuli Testis. Radiating from the corpus of Highmore or mediastinum testis and dipping into the testicle are bands of connective tissue termed the

septuli testis which divide the parenchyma of the testicles into lobules (Fig 61) and also unite with the peripheral tunica albuginea, so that each lobule contains two or more seminiferous tubules

The seminiferous tubule is a tortuous almost microscopic structure, has a blind end and unites with the other tubules in the lobule to form the tubuli recti directed toward the mediastinum of the testicle. The tubuli all empty into an intertwining, interconnecting network of tubules at this point, the rete testis

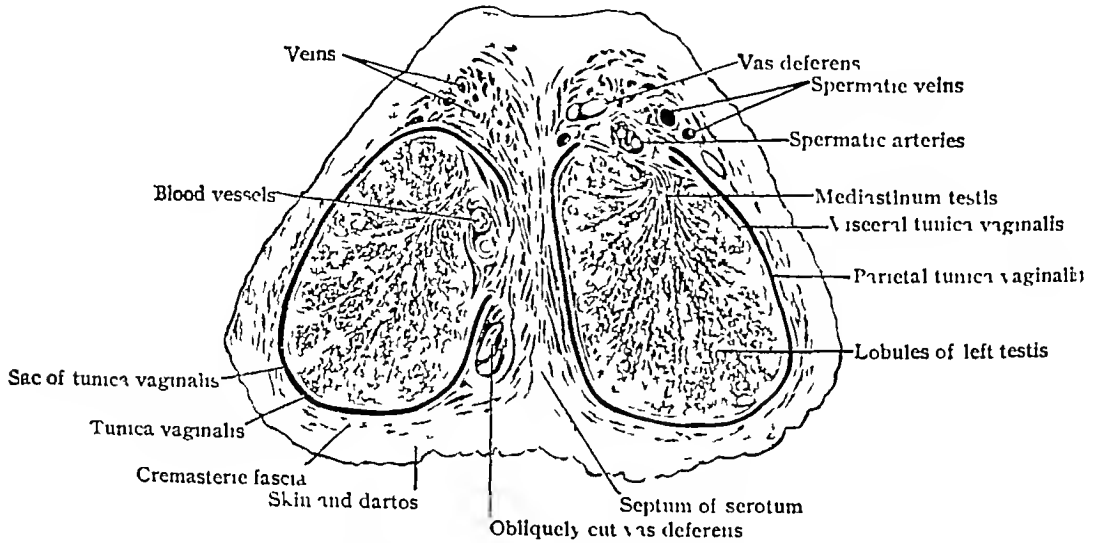


FIG 61—Section across formalin-hardened scrotum, showing lower end of spermatic cords and testes in section (Piersol)

CELLS

The microscopic anatomy of the testicle presents three distinct structures that are of importance. The interstitial cells of Leydig are located in the loose connective tissue between the tubules and are by many still considered the source of the internal secretion, although recent observations tend to disprove this. They are round or polygonal in shape with distinct cell boundaries.

The sustentacular or supporting cells, or cells of Sertoli, are located in the basement membrane of the seminiferous tubule and extend forward toward its lumen. They are cylindrical in shape, have an ovoid nucleus and have fat droplets in their protoplasm. Their function is still disputed—they may produce the internal secretion.

The epithelium of the seminiferous tubule is the source of spermatogenesis and it goes through various stages in the development of the spermatozoon. The spermatogonia or mother cells, in the basement membrane are the first stage in the development of the spermatozoa. These later develop into spermatocytes which are larger than the spermatogonia. The spermatocytes, by cell division, divide into four spermatids. Each spermatid develops into a spermatozoon. The generative cells, unlike somatic cells, do not undergo karyokinesis, so that the number of chromosomes in each spermatozoon is one-eighth that of the spermatocyte. The nucleus is called the pronucleus and unites with that of the ovum to produce the nucleus of the fertilized ovum. (See also chapter on sterility in the male.)

The mature spermatozoon has a head, neck and tail. The nucleus is in the

head and the head penetrates the ovum in fertilization. The neck and tail then disappear.

BLOOD AND LYMPHATIC SUPPLY

The chief blood supply of the testicle is the internal spermatic artery, a branch of the aorta which enters the mediastinum testis and there subdivides in ramifying branches supplying the entire parenchyma of the testis. A branch is given off before it enters the testicle to the epididymis. The artery accom-

FIG. 62

FIG. 63

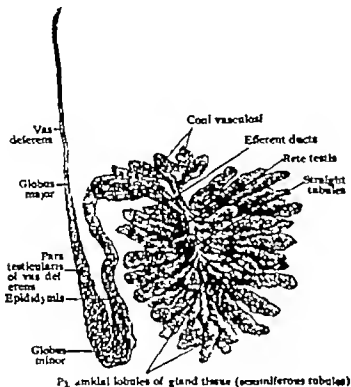


FIG. 62—Dissection of testicle after tubules have been filled with quicksilver. Testis has been separated into the component lobules. (Piersol.)

FIG. 63—Lymphatics of testis. The drainage is along the spermatic lymphatics towards the nodes lying at the bifurcation of the aorta and in an upward direction towards those of the upper abdominal region.

panying the vas deferens supplies the body and tail of the epididymis and also to some extent the testicle. The external spermatic artery, a branch of the deep epigastric, enters the lower pole of the testicle. The veins accompany the arteries in the testicle and epididymis and form a plexus in the spermatic cord called the pampiniform plexus.

The lymphatics draining the testis follow the spermatic cord and enter the lumbar nodes (Fig. 63). The lymphatics of the epididymis and lower portion of the vas deferens drain into the external iliac and inguinal nodes. The nerves supplying the testicle and epididymis accompany the artery and are derived from the aortic and spermatic plexus of the sympathetic nerves.

From birth to the eleventh year the testicle is 1.6 cm. long but it grows rapidly from the 12th to the 16th year so that it becomes 3.5 cm. long and

2.6 cm wide In adults, the average length is 4 to 5.5 cm and 2.6 to 3.5 cm wide

THE EPIDIDYMIS

The epididymis (Fig. 62) as it lies on the posterior surface of the testicle is somewhat crescentic in shape and about 5 cm long. It is closely invested by the tunica vaginalis except at the head and tail. The body of the epididymis is attached to the testicle somewhat loosely by an infolding of the tunica, forming here a depression called the digital fossa. The tail of the epididymis and the lower pole of the testis is attached to the loose tissues of the scrotum by the gubernaculum testis which fixes the testis in place. The gubernaculum is a fold of peritoneum which gradually descends downward with descent of the testicle and may be an important factor in this descent. The vasa efferentia, 12 to 15 in number emanating from the rete testis and derived from the wolffian body, are thin tubules lined by ciliated epithelium, each about 1 cm long continuing and uniting at the head of the epididymis. At the head, each vas efferens with its capillary forms a conus vasculosus, and all combined form the conus vasculosus. The conus vasculosus all communicate and end in the single duct of the epididymis at the head.

The epididymis is a single tubule, very much coiled and twisted upon itself and is continued at the globus minor as the vas deferens. The coils of the tubule are held firmly together by areolar connective tissue lying beneath the tunica vaginalis. In this areolar connective tissue are contained some smooth muscle fibers which produce contractions of the tubule. The muscle fiber in its sheath is most marked in the tail and is quite noticeable in the breeding season of lower vertebrates. The tubule of the head and body does not have muscular fibers in its wall, the tail has some.

At the head of the epididymis, a number of coils of the tubule are grouped and banded together by the areolar connective tissue producing a compartment-like formation. The entire epididymis, except the tail, is, in fact, blocked off into a continuous compartment of coils directed toward the vas deferens. At the tail, however, this compartment formation ceases, the coils becoming separated from each other although still held firmly together by the areolar tissue.

The tubule itself, if unwound, would measure about 20 feet in length. It is about 4 mm in diameter, except at the tail, where it is much thicker, approaching very closely the size of the vas. The tail compares with the rest of the epididymis as does the large to the small intestine. The junction between the lower part of the body and tail is quite irregular, the tubule here, as stated above, separating out as a single tubule and not a compartment of tubules as in the rest of the epididymis.

At the junction of the body and tail, the tubule makes a number of acute angles upon itself and at this point the tubule becomes much larger and thicker. There may be a valve at this junction, similar to the ileo-cecal valve.

The epithelium of the epididymis tubule is not ciliated and has projecting ends dipping into the lumen, from which its secretion escapes into the lumen.

The aberrant vas of Haller, a remnant of the wolffian body, sometimes

1 to 2 inches long is usually present and is located near the junction of the body and tail

A superior aberrant vas is sometimes seen emanating from either the rete testis or head of the epididymis

The hydatid of Morgagni or appendix testis (the non pedunculated hydatid) is found in 90 per cent of testes and is quite constant. It arises from the groove between the globus major and the testicle and consists of vascular connective tissue with some canals lined with epithelium. It is a remnant of the upper end of the müllerian duct

The appendix epididymis or pedunculated hydatid is sometimes seen as a small pedunculated pear shaped mass and arises from the pinching off of one of the efferent ducts at the head of the epididymis where it is located

The paradidymis or organ of Giralde lies as an oblong body in the lower most end of the spermatic cord in front of the vessels at the mediastinum testis. It consists of groups of microscopic vesicles and tubules which are partly the remains of the posterior part of the wolffian body

THE VAS DEFERENS

The vas deferens is the duct in the genital tract analogous to the ureter in the urinary tract conveying the sperm to the seminal vesicle (which in turn is analogous to the urinary bladder) from the epididymis. The vas deferens is a continuation of the epididymis beginning at the globus minor of the epididymis and terminating in the neck of the seminal vesicle forming a large part of the seminal duct. By the seminal duct is meant the epididymis vas deferens seminal vesicle and ejaculatory duct. The urethra although also a part of the seminal duct, is not usually included

The vas is 20 to 24 inches in length and has a winding course which is altered with the movements of the testicle and the filling and emptying of the bladder and also by the elasticity and redundancy of its structure. Beginning at the epididymis, it is quite tortuous and after one or two inches upward this tortuosity ceases and the duct is smooth and even throughout until the ampulla is reached. The first inch or two of the vas is not as thick as the rest the tubule gradually increasing in thickness in this portion

Divisions. In its course it is divided into 1 intravaginal portion within the tunica vaginalis 2 the scrotal vas within the scrotum to the external abdominal ring 3 the inguinal portion, between the external and internal inguinal ring 4 the pelvic vas—all of the vas beyond the internal inguinal ring up to the ampulla, and 5 the ampulla. Clinically the vas is divided into the scrotal and pelvic vas the latter being all the vas back of the internal inguinal ring and the former all in front this portion being readily accessible in the groin and scrotum

1 **THE INTRAVAGINAL PORTION** This is the first part of the vas within the tunica vaginalis and is 2 3 inches long. It has no sheath.

2 **THE SCROTAL VAS** This is the portion of the vas deferens which can be felt in the scrotum and up to the inguinal ring and is 5 7 inches long. It is covered by a sheath. This portion forms part of the spermatic cord and near the inguinal region is called the funicular portion

3 **AN INGUINAL PORTION** from the external to the internal abdominal ring is about $1\frac{1}{8}$ inches long and the rest constitutes the pelvic vas. Up to this point, the vas has followed along the posterior border of the testicle to form part of the spermatic cord and ascends the inguinal canal. Beyond the internal inguinal ring, it leaves the spermatic cord and from here on, follows a winding irregular course.

4 **THE PELVIC VAS** At the internal ring, the vas curves around the outer side of the internal epigastric artery and vein and makes a sharp bend at this point. It crosses the external iliac artery and descends into the pelvis at the side of the bladder, crossing in front of the ureter, then passing inward and downward to form the ampulla. In its development from the genital ridge, the testicles and its ducts lie in front of the kidney and its ducts, thus explaining the crossing of the vas anteriorly, over the ureter (See Fig. 36.)

5 **THE AMPULLA** This dilated spindle-like enlargement of the vas is about $\frac{3}{4}$ inches long. Whereas, except in the first inch or two, the wall of the vas is even and smooth throughout, the ampulla presents a series of puckering and diverticula in its wall throughout its length. It enters the neck of the seminal vesicle obliquely (Fig. 50) and at this point, the neck of the vesicle and the ampulla are surrounded by a sphincter.

The Sheath of the Vas Deferens Beginning at the ampulla, to a certain extent as a continuation of the sheath of the seminal vesicle and ampulla, the sheath covers the vas in its entire length until it dips into the tunica vaginalis. The sheath of the vas covering the pelvic portion is quite firmly attached to it, that covering the scrotal portion, is a loose covering. Except in a small percentage of cases, the sheath of the pelvic and scrotal vas is not continuous. At the internal inguinal ring, where the spermatic cord forms a loose band of connective tissue between the pelvic and scrotal sheath, surrounding it, a space intervenes. This is called Bogros space. It is at this point that funiculitis develops, due to extension of infection along the sheath from the seminal vesicle. Pelvic abscess in the male also points here quite often. The scrotal vas slides in and out of its sheath so that it is really a tube within a tube. As it dips into the tunica vaginalis, its sheath leaves it and spreads over the tunica.

The Spermatic Cord This begins at the internal inguinal ring, where the spermatic arteries and veins and the vas deferens enter the inguinal canal, and from this point on, constitute the spermatic cord. It is covered by fibers from the intercolumnar, cremasteric and infundibuliform fasciae and the fibers of the cremaster muscle lie upon its sheath, accompanying it all the way. The cord ends at the posterior margin of the testicle and also contains the pampiniform plexus, lymphatics and nerves and the blood vessels accompanying the vas. At the point where the vas enters the testicle, the sheaths above mentioned, leave the cord and terminate by encircling and covering the parietal layer of the tunica vaginalis.

Structure of the Vas The vas can be felt in the scrotum as a hard cord that is distinct from the rest of the spermatic cord. It has a thick layer of unstriped longitudinal muscle which gives it its toughness. It contains no circular fibers. Its mucosa, arranged in longitudinal folds, has columnar epithelium which is not ciliated. The ampulla is somewhat nodular and shows depressions in its wall.

The blood supply is from the deferential artery and vein, which gives off branches along its course. This artery also acts as a splint for the vas.

Lymphatics. The lymphatics of the vas are not continuous along the course of the vas. Those accompanying the pelvic portion drain into the inguinal and iliac nodes and those accompanying the scrotal vas drain upward into the iliac and lumbar nodes. Thus infection cannot travel from the seminal vesicles to the epididymis by way of the lymphatics, because of lack of continuity of the lymphatics of the vas.

The Seminal Vesicles. The seminal vesicles are two lobulated membranous pouches, into which the ampullae of the vasa deferentia enter. The vesicles lie between the base of the bladder and the rectum, and above and behind the prostate. The long axes of the vesicles run forward and downward at an angle of 30-45 degrees from the median line and both vesicles converge to the median line to end in the ejaculatory ducts. The ampulla enters the neck of the seminal vesicle (Fig 50). The ejaculatory duct is a continuation of the seminal vesicle and is not formed by the junction of the vas and seminal vesicle as stated in most text books. The ampulla runs for some distance alongside the seminal vesicle on its inner surface before entering it.

The anatomy of the vesicles was not well understood until radiograms of these structures were made. These structures are peculiar to man, all lower animals having only solid glandular structures, mis-called seminal vesicles but really seminal glands. The vesicle acts as a reservoir for semen and is analogous to the urinary bladder. Each vesicle consists of a single tube coiled upon itself and giving off irregular cecal diverticula, the coils as well as the diverticula being connected by fibrous tissue. When uncoiled it is 4-5 inches long. The average capacity of the vesicle as shown fluoroscopically is 4-5 cc. Each sac is somewhat pyramidal in form, the upper end being wider and lying in front of and close to the ureter, thus explaining ureteral stricture and occlusion from seminal vesiculitis. The tip of the upper third of the seminal vesicle is covered by peritoneum and on its posterior surface is separated from the rectum by the fascia of Denonvillier. The vesicle has a sheath which covers it, and also the lower end of the ampulla. The vesicle has a markedly irregular twisted channel as first shown by Picker in his radiograms of post mortem specimens. He divided them into: 1. Simple straight tubes. 2. Thick twisted coils with or without diverticula. 3. Thin twisted tubes with or without diverticula. 4. Straight or twisted main channel with large bulbous diverticula. 5. Short main channels. 6. Variations from the normal. The vesicles vary markedly in size and form, one side often varying from the other. Anomalies are often seen. Four to eight blind tubular diverticula usually branch from the chief duct at varying angles and directions.

The wall of the seminal vesicle contains smooth muscle fiber, an inner and outer coat which is longitudinal and a middle coat of circular fibers. There are many multilocular cavities lined with secreting cylindrical epithelium. It is surrounded by elastic tissue fibers and is abundantly supplied with sympathetic nerves with ganglia around its periphery.

It has an abundant blood supply derived from the inferior hemorrhoidal

and inferior vesical branches of the internal iliac artery, the main point of entry of these being in the upper and outer border of the vesicle. The nerves are derived from the pelvic plexus and the lymphatics drain into those on the internal iliac vessels.

The vesicles remain small until puberty when they develop rapidly and assume their full size and function.

The Ejaculatory Ducts These are two in number and are the continuation and outlet ducts of the seminal vesicles. Each duct is about three-fourths of an inch in length, runs forwards and downwards between the middle and posterior lobes of the prostate and along the side of the sinus pocularis to terminate in slit-like openings on each side, or on the lips of the utricle (Fig 50). It is a tortuous inelastic fixed duct with an epithelial lining and a fibrous coat. It presents many anomalies in its opening into the posterior urethra.

It may be found on the floor of the utricle, this being merely a reversion to the type seen in lower vertebrates.

Cowper's Glands These, also termed bulbourethral glands, are two small lobulated yellowish bodies, about the size of a pea which lie between the two layers of the triangular ligament. Their ducts open into the bulbous portion of the urethra. Each gland is composed of a number of lobules which open into a common excretory duct about one inch long.

CHAPTER 3

PHYSIOLOGY¹

URINARY TRACT

KIDNEY

PHYSIOLOGY OF THE NERVES OF THE

KIDNEY

THE RENAL PELVIS

THE URETER

THE BLADDER

PHYSIOLOGY OF MICTURITION

THE URETHRA

GENITAL TRACT

THE SCROTUM

THE TESTICLES

VASA EFFERENTIA

THE EPIDIDYMIS

THE VAS DEFERENS

SEMINAL VESICLES

THE PROSTATE GLAND

THE VERUMONTANUM

GLANDS

THE PENIS

THE SEMEN

THE SPERMATOZOA

URINARY TRACT

KIDNEY

For many years, the kidney was considered to possess only purely excretory functions which consisted in removing water and salts in different concentrations from the blood. These substances, excreted in the urine, would not be changed by the kidney, i.e. none of the substances present in the urine were formed by the kidney itself. Recent studies have shown that other non-excretory functions of the kidney are also of great importance, hence we shall take the excretory and non-excretory functions separately.

I Excretory Functions of the Kidney

THE CLASSICAL THEORIES of Bowman (1843) and of Ludwig (1844) have been discarded. Both assumed that simple filtration took place in the glomerulus. According to Bowman, a true vital secretion also took place in the tubules, while according to Ludwig, the diluted glomerular filtrate is concentrated during its passage through the tubules by simple osmosis.

THE MODERN THEORY of the function of the glomeruli and tubules is based on the investigations of Wearn and Richards, Cushny, Starling and Verney (Fig. 64).

It has been proven beyond a doubt that an ultrafiltrate of the blood plasma is formed in the glomeruli. The glomerular filtrate contains all crystalloid substances of the blood plasma in the same concentration in which they are present in the blood, but the colloids, especially the proteins, do not pass through the glomerular membrane.

In the tubules, a reabsorption of water and different substances takes place. It can no longer be doubted that not only reabsorption, but also excretion takes place in the tubules. During the passage through the tubules, the original glomerular filtrate is changed into the definite urine.

THE HEIGHT OF THE BLOOD PRESSURE in the loops of the glomerular capsule is of primary importance in the simple physical filtration process which takes

¹This section on Physiology of the kidney as it appeared in previous editions, has been revised with the aid of the articles by Prof. I. Snapper (Holland) *Brit. Jour. Urol.* 1937 9 1 on Pathological Physiology of the Functions of the Kidney and by Dr. L. Dambrin (France) on Physiology of the nerves of the kidney *Arch. Mal. des Reins*, 1934 8, 261.

place there The secretion of the kidney stops when the aortic pressure goes down to 50-60 mm Hg When the hydrostatic pressure in the glomerular loops (which varies from 27-32 mm Hg) is equal or lower than the colloid osmotic pressure of the plasma, the secretion of urine ceases

Richards and Barnwell (1927) have shown that glucose, chlorides and bicarbonate are reabsorbed in the tubule

REGULATION ACID-BASE The kidney has an important function in the regulation of the acid-base equilibrium of the blood The healthy kidney often has to remove large quantities of acid, sometimes large quantities of alkalis from the blood (Gamble, 1922) Excretion of such alkali or acid might damage the kidney parenchyma This is prevented by remarkable protective mechanisms by which a considerable amount of acid or alkali can be excreted, while the reaction of the urine does not become too acid or too alkaline

The base necessary to neutralize completely the chloride and sulphate ions in the urine is formed in the kidney, in the form of ammonia In a similar

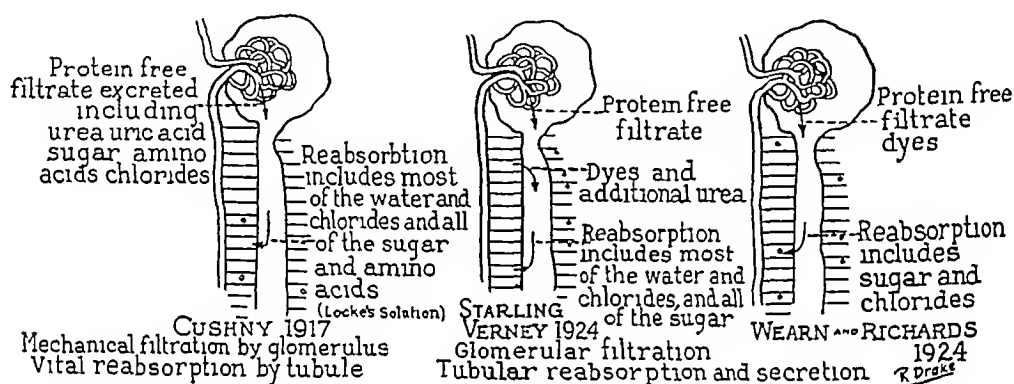


FIG 64—Schematic representation of various studies on renal physiology (From article by P S Hench in Jour A M A)

way, the organism is protected against loss of too much acid during the excretion of bases in the urine Whereas the body forms ammonia to bind the acids of the urine, it disposes of large quantities of carbonic acid to neutralize the bases of the urine The amount of Free CO_2 of the urine is always equal to the free CO_2 of the plasma The equilibrium of this free CO_2 in the urine with the bicarbonate present in the urine prevents pH of the urine rising above pH 8

II Non-excretory Functions of the Kidney

The kidney also has other functions than that of excretion of urine The following syntheses and oxidations take place

- (a) Important syntheses (hippuric acid, phenaceturic acid, cinnamoylglycocoll)
- (b) Oxidation of ketone bodies
- (c) Complete and incomplete B-oxidation of aromatic fatty acids to benzoic acid, phenylacetic acid and cinnamic acid
- (d) Formation of ammonia (probably from amino acids)

PHYSIOLOGY OF THE NERVES OF THE KIDNEY

The direct vasomotor innervation of the kidney is furnished by the sympathetic nerves (see Chapter 2, Anatomy) Their stimulation is followed by

vasoconstriction and their section by vasodilatation. The trunk of the vagus does not appear to act directly on the renal vasomotor innervation. Stimulation of the cervical portion of this nerve is followed by cardiac inhibition then by bulbar ischemia and vasoconstriction of all of the viscera including the kidney.

The nerves play a part in renal secretion but there is no specific secretory nerve. All of the secretory changes observed following stimulation or section of the nerves can be explained by variations of the intrarenal circulation.

The central nervous system has no direct action on renal secretion.

Urinary secretion is governed by intrarenal nerve centers which are adequate to control all secretory phenomena. It does not appear probable that the peripheral nervous system should have an important influence on the autonomic intrarenal nerve centers. A kidney which has been denervated or transplanted reacts to all stimuli just as does a kidney with intact nerve supply.

Histological study has thus far according to Dambrin not furnished the proof of the existence of such autonomic centers.

The Principal Sensory Reflexes of the Kidney

- 1 A renorenal reflex due to nerve anastomoses between the two kidneys
- 2 A renovesical reflex due to nerve anastomoses between these two organs
- 3 A renoureteral reflex, which explains the anuria during passage of a calculus or following ureteral catheterization

REFLEX ANURIA OR OLIGURIA. This is observed as the result of the blocking of the outlet of the renal pelvis or ureter by a calculus resulting in partial or complete reflex inhibition of the secretory activity of the opposite kidney. It is also observed after ureteral catheterization. In both of these the existence of a renorenal or a ureterorenal reflex action offers the best explanation.

REFLEX POLYURIA is the result of emotional influences and is not infrequently observed in nervous individuals during ureteral catheterization.

The kidney nerves do not appear to have an important trophic influence nor histological changes following denervation.

THE URINE

Most of the waste products resulting from metabolism are excreted in the urine. It is a clear yellow fluid its color varying with its concentration as does the specific gravity. The latter varies normally from 1.016 to 1.024 (except with great fluid intake when it is less) and the reaction is acid. The average amount excreted daily is about 1500 cc. The constituents of the urine are divided into the inorganic acids and bases and the organic nitrogenous substances. The inorganic acids are the chlorides, sulphates and phosphates. The bases are potassium, sodium, magnesia and calcium. The chief organic substances of the urine are urea, ammonia, creatinin and uric acid. The rate of excretion of the organic nitrogenous substances is an important index to the protein metabolism of the body and any decided increase above the normal is an indication of disturbed metabolism or deranged renal function.

THE RENAL PELVIS

Peristaltic waves initiating in the calices carry the urine downward. The pelvis is a temporary reservoir, its emptying time varying from one and one-

* See Dambrin—Physiology of Nerves of Kidney Arch. Mal. Reins 1934 8, 261

half to four minutes, so that under normal conditions, urine is retained here but a short time. Its capacity varies considerably, particularly with artificial distention as in pyelography, but normally it does not hold more than 5-7 cc of urine. The filling of the pelvis with urine stimulates the terminal nerve filaments and initiates a contraction of its musculature.

THE URETER

The ureters carry the urine to the bladder by peristaltic waves, produced by the stimulation of their autonomic and sympathetic nerve fibers upon its musculature. The two ureters do not expel urine simultaneously. They are independent of each other and of the filling of the bladder.

Trattner (Jour Urol 1932, 28, 1) has been able, with the use of a hydrophorograph (water wave recorder) to study normal ureteral peristalsis in a very accurate manner. The longitudinal contractions shorten and narrow the ureter but do not obliterate the lumen. The circular contractions momentarily obliterate the lumen in successive segments as the wave advances. The longitudinal and circular contractions occur simultaneously but whereas the former quickly involves the entire ureter, the latter (circular contraction) can be seen coursing successive segments. Complete relaxation occurs as soon as the circular contractions have terminated. Both the longitudinal and circular contractions usually begin at the upper end and proceed toward the bladder, but exceptionally the reverse i.e. antiperistalsis may occur. From a physiological and pharmacological point of view, the ureter is divided into an upper, a middle and a lower third. These separate divisions or any combination frequently contract independently.

The normal variation in the rate or frequency of contraction is from one every 2-3 minutes up to 5-6 contractions per minute.

The longitudinal or circular muscular coat may be involved separately or simultaneously in spasm. This will be taken up later in Chapter 30 on Ureteral Stricture.

There are many factors which influence ureteral peristalsis, such as age, sex, nutrition, blood flow and oxygen-carbon dioxide content of the blood, the pH of the urine, intra-abdominal (especially pregnancy) and bladder pressure, introduction of solutions or instruments (catheters, etc.), bacterial toxins and drugs. Amongst the latter, those which increase peristalsis are nicotine, choline and acetylcholine, morphine in high or moderate concentration, calcium and potassium chloride and dilute pituitary extract. Drugs which decrease or inhibit peristalsis are adrenalin, atropine, pilocarpine, papaverin hydrochloride and the barbiturates.

THE BLADDER

The bladder is a hollow organ which distends readily and varies in size according to the quantity of urine it contains. It receives and retains the urine from the ureters until the stimulus for micturition arises.

PHYSIOLOGY OF MICTURITION

As soon as a measurable quantity of urine is present in the bladder, a pressure of 6-10 cm of water develops and is maintained in a remarkably constant fashion until a considerable quantity of urine accumulates. The point

at which the balance between the volume of the contents of the bladder and its pressure is disturbed varies somewhat with external conditions. The intravesical pressure is influenced by psychic stimuli (sounds and odors), by the temperature of the air and by changes in posture and activity (standing erect coughing laughing straining) all of which may increase the intravesical tension. In the absence of such factors, the intravesical tension begins to rise when the volume of the contained urine approximates 200-400 cc. when the tension reaches from 18-30 cm of water the individual becomes conscious of a desire to urinate. When this occurs one of two sequences may develop depending on whether or not it is convenient to urinate. If it is not the external sphincter is voluntarily contracted presumably by stimulation of its center in the paracentral lobule of the cerebral cortex via association paths connecting it with the sensory center. Closure of the internal sphincter is maintained by its tone. The desire may then disappear for a time probably by a conscious effort involving inhibitory impulses via the hypogastric nerves.

The mechanism is somewhat different when a normal desire to urinate exists and circumstances permit emptying of the bladder. Here the intravesical pressure being only from 18-30 cm of water is insufficient to bring about emptying of the bladder. The precise manner in which the pressure is now elevated, that is detrusor contraction brought about, is not clear according to Creevy.³ It was and is still widely held⁴ that this is accomplished by the motor center for micturition in the cerebral cortex. It also seems that contraction may be brought about by a contraction of the abdominal muscles which in turn elevates the intravesical pressure sufficiently to stimulate a local detrusor and trigonal contraction. Whether detrusor contraction can be brought about by direct influence of a cerebral center on unstriated muscle like the detrusor is doubtful. Most probably the detrusor contraction is effected by the accumulation of urine leakage being prevented by the tone of the sphincters. The increased intravesical pressure produces the "desire to void" in the cerebral cortical center and the latter relaxes the external sphincter willfully. The trigonal muscle⁵ pulls open the internal sphincter and urine escapes.

The bladder has flat transitional epithelium and no glandular structures thus preventing absorption of its contents into the lymphatics or blood. Absorption of bacteria or dyes from the bladder is very slight or almost nil. The bladder is resistant to primary infection so that a cystitis does not result merely from the deposit of bacteria in the bladder except when the bacteria are very virulent. Congestion and retention are also necessary factors in the production of a cystitis. Cystitis per se is uncommon. It is usually secondary to infection from above or obstruction from below. Except for the trigonal mucosa the bladder is never infected by gonococcus because it does not attack a mucous membrane which is loosely attached as is that of the bladder.

In the urinary tract dyes and bacteria pass most readily into the circulation from the renal pelvis and posterior urethra next in frequency from the trigone. The anterior urethra and ureters are still less absorptive and the bladder

In the revision of this section for the present (1935) edition, we are indebted to the articles by Dr C D Creevy Arch. Neurol. and Psych. 1935 34 777 and Jour. Urol. 1936 35 507.

Forster Kennedy Jour. Urol. 1936 36, 255

Young and Weston maintain that the internal sphincter is pulled open by the contraction of the trigonal muscle.

least of all The regenerative capacity of the bladder is very marked Rapid regeneration follows, after radical resection of a large portion of the bladder, whereas the kidney has practically no regenerative properties The ureter, like all epithelial lined ducts, will sometimes regenerate when injured or ligated, and the urethra has remarkable regenerative capacity as shown after prostatectomy and external urethrotomy

THE URETHRA

The posterior urethra has circular fibers which augment the action of the bladder sphincters Secretion in the posterior urethra if of appreciable amount, is forced into the bladder by the tonic contraction of the external sphincter, which is more powerful than the internal sphincter of the bladder The urethral mucosa is closely apposed when the urethra is collapsed, this close apposition maintains an even balance of pressure throughout the urethra, and thus helps to expel all the urine at the end of urination The urethra is also part of the seminal duct Variations in strength and character of the urinary stream depend upon variations in expulsive force of the bladder, as well as obstructions at the vesical neck and obstructions or irregularities in the urethra The urethral meatus is narrow in relation to the caliber of the rest of the urethra, and thus helps to give added force to the urinary stream The male urethra is also a part of the seminal duct, and contains glandular structures which produce an alkaline secretion during erection and coitus

THE GENITAL TRACT

THE SCROTUM

The scrotum of the human has a very important function in being thermoregulatory⁶

The testicles lose their spermatogenic function within the abdomen because of the excessive heat, so that the intraabdominal undescended testis does not produce spermatozoa In order that the testicles function properly, they must lie within the scrotum, where the temperature is a few degrees lower than that of the abdomen and where they are not under the influence of pressure One testicle usually hangs lower than the other in order to prevent injury or discomfort from their apposition Contraction and relaxation of the scrotum as the result of cold or heat, elevates and depresses the testicle as does also the contraction of the cremaster and the elasticity of the vas

The regenerative capacity of the scrotum is remarkable Following gangrene of the scrotum, with the testicles entirely exposed, complete regeneration will occur within a few weeks

The skin of the scrotum near the thigh, and also that of the inner aspect of the thigh, produces a characteristic secretion

THE TESTICLES

The male hormone has been isolated and standardized, and its effects studied by Moore, Koch, and other investigators The testis has two hormones, chief of

⁶C R Moore Action of displaced testes and its bearing on problem of function of scrotum
Am J Physiol 77, 59, June, 1926

which is androsten, the other is inhibin, which acts indirectly on the pituitary gland. Very little hormone is ever present at one time in the testis; a far larger quantity can be found in the urine. The male hormone found in urine, is, however, slightly different from that found in the testis itself. There is a definite relationship between the pituitary gland and the testis, both directly and indirectly controlling the accessory sex organs: the prostate and seminal vesicles. Inhibin has been made use of clinically in the attempt to treat prostatic hypertrophy. It is interesting to note that in both the urine and blood more of the opposite sex hormone is found than of the same sex hormone. The Gonadotropic principles found in the urine consist of prolactin-A which affects proliferation of the seminal tubules, and prolactin-B which acts to partly control secondary sex characteristics. The male hormone has been synthesized in large quantities from cholesterol. (This subject will be considered further in the chapter on Sterility.)

The spermatogenic function of the testicle is located in the seminiferous tubule. The epithelium of the seminiferous tubule constantly produces spermatogonia, which change into spermatocytes, then into spermatids and finally develop into spermatozoa. The seminiferous tubules are probably the most sensitive structures of the body. Production of spermatozoa is diminished or ceases in acute infections and chronic disorders. Variations in the production of sperm occur often with only slight changes in the state of general health.

The tubuli recti and rete testis (Fig. 62) do not produce the sperm. They are only the passageways for the fully developed spermatozoa. The rete testis is a temporary reservoir like the pelvis of the kidney and in birds it is well developed. The spermatozoa in the testicle are not motile.

The testicles have considerable immunity to systemic infection and also considerable resistance against local infection. Tuberculosis is practically never primary in the testicle itself and gonorrhea rarely affects it.

The regenerative capacity when a part is resected is nil. Unlike the pancreas in which blocking of the pancreatic duct causes cessation of the production of its external secretion, the testis continues to produce spermatozoa, although at a diminished rate for many years after the epididymis has been blocked. This permits for a successful end result following the various short circuiting operations recommended for the relief of obstructive sterility in the male even though the obstruction has been of many years' duration.

VASA EFFERENTIA

The ciliated epithelium of the vasa efferentia wafts the sperm along the convoluted (Fig. 62) of the head of the epididymis where they pass into the single epididymis tubule.

THE EPIDIDYMIS

(Fig. 62) The epididymis has three distinct functions. It is a passageway for sperm, a secretory organ and it also excretes. It is in fact an accessory sex gland.

That this coiled tube which is twenty feet long is not merely a passageway for the spermatozoon which is one five hundredth of an inch long and does not require this long passage is well shown by the fact that the secretion of the epididymis constitutes the bulk of the semen. The epithelium of the epididymis secretes a fluid whose function is not entirely understood. In a man with both

epididymes blocked, the quantity of semen is one-sixth or one-eighth of the normal, although the sperm constitutes only about one-tenth of the semen. Its excretory function has been demonstrated by Belfield and Rolnick. Dyes injected intravenously into dogs, uniformly show the body of the epididymis colored. The sperm heads of the spermatozoa lying in the body and some in the tail also take up the dye. These observations have been recently confirmed by one of us.

The epididymis has no ciliated epithelium, the sperm being carried along by the secretory pressure and by the contraction of smooth muscle in the sheath covering the epididymis.

The secretion of the epididymis activates the sperm very little, for the spermatozoa are motile in only a small percentage of the cases, in the head of the epididymis and then only slightly, and there is no great motility in the tail.

The epididymis has the regenerative capacity of all epithelial lined ducts, for potency is often restored after epididymotomy. The tail of the epididymis, having smooth muscle in its wall, has powers of contraction. When the sperm have gone beyond the body of the epididymis into the tail, they cannot be forced in a retrograde direction, because of a peculiar tortuosity or valve-like arrangement between the body and tail. This probably explains the cases of erotic epididymitis. The sperm accumulates in the tail of the epididymis, a far greater quantity being present here, than elsewhere in the epididymis.

For the purpose of analogy with the urinary tract the body of the epididymis can be compared with the kidney and the tail with its pelvis—the body being a secretory and excretory organ and the tail, a reservoir for the sperm.

THE VAS DEFERENS

The thick longitudinal smooth muscle fibers in its wall contract upon stimulation, but the peristalsis is not the same as that of the ureter, due to the absence of circular fibers. One sees a little wrinkling of the wall of the vas but no peristaltic waves, although the latter may be present during coitus. The vas has considerable elasticity, particularly its scrotal portion and is quite redundant, and through this is able to accommodate itself to the movements of the testicle and the filling and emptying of the bladder. It has no ciliated epithelium, the sperm, which are only slightly motile in the vas, being carried along by secretory pressure and the peristalsis of the vas.

The sheath of the vas acts as a splint in injuries of the vas, just as does the periosteum of bone or a tendon sheath. The remarkable regenerative capacity of epithelial lined ducts is here also exemplified. The vas regenerates and the potency is restored following simple ligation or resection of less than 1 inch as has been demonstrated by one of us.

The ampulla of the vas deferens (Fig. 50) is physiologically a distinct structure which contains a secretion that activates the sperm to a marked degree, for they are actively motile here.

Fluid injected through the vas fills up the ampulla and vesicles but when injected through the ejaculatory duct, fills up the seminal vesicle first and only enters the ampulla, after considerable pressure is employed. The valve like arrangement at the insertion of the ampulla into the neck of the seminal vesicle, together with the oblique insertion of the ampulla, is similar to the insertion of the ureter into the urinary bladder, thereby preventing fluid from passing beyond the seminal

vesicle just as urine is prevented from passing up the ureter from the bladder, except in cases of bladder reflux.

No reverse peristalsis of the vas has been demonstrated. The vas can well be compared to the normal ureter in this respect

SEMINAL VESICLES

The seminal vesicles of the human are true reservoirs for semen and are analogous to the urinary bladder which is a reservoir for urine. Fluid injected through the vas fills up the seminal vesicle before overflowing through the ejaculatory duct. The spermatozoa enter the vesicle and remain there until expelled.

The sphincters at the neck of the seminal vesicle and about the ampulla allow the seminal vesicles to retain their contents except when peristalsis of the vesicles occurs. The seminal vesicles do not, however, retain all their contents until ejaculation occurs, but contract at intervals expelling their secretions. The mechanism here is similar to that of other hollow organs containing smooth muscle, involuntary contractions occurring in a manner similar to that of the gall bladder.

Thus colored fluids injected into the vesicles are found in small amounts daily until they are entirely expelled. The urine of most men contains a few spermatozoa at various times.

The contraction of the seminal vesicles may be due to the smooth muscle in its wall or the vesicle may be considered as merely a bag similar to the gall bladder which distends and empties. The contraction of the elevator ani is (Fig. 59), however, also an important factor in expelling the contents of the vesicles.

The seminal vesicles of all lower animals except the anthropoid ape are glandular structures having no communication with the vas and are merely secretory as is the prostate and should be properly termed *glandulae seminales*.

The seminal vesicles also produce a secretion which adds to the bulk of the semen. This secretion activates the sperm markedly and contains a protein which gives a ring test to nitric acid. This is, however, serum globulin and not serum albumin. The vesicles have no glandular structures to ward off infection and in infection of these structures the ampulla of the vas is equally involved.

Removal of the seminal vesicles results in impotence.

The pleasurable sensation at the height of orgasm is due to the passage and squeezing of the semen through the ejaculatory ducts. The ducts are tortuous, inelastic, fixed and allow but poor drainage for the vesicles.

THE PROSTATE GLAND

The prostate is the largest accessory sex organ and gives off an alkaline secretion which adds materially to the total bulk of the semen. This secretion gives the peculiar odor to the semen and helps activate the sperm and prolongs their life. It protects the sperm from the acid secretion of the vagina through the protective action of the prostatic plug which envelops the sperm.¹ The prostatic secretion, however, is not necessary for activating the sperm which are already motile in the seminal vesicle.

It is also a muscular organ and reinforces the bladder neck and prostatic urethra. There is no evidence that the prostate produces an internal secretion.

¹The term sperm is an abbreviation for spermatozoa.

It is easily infected in gonorrhea, hence an infection may persist here for a long time. Its glandular structure, however, helps it to combat infection.

THE VERUMONTANUM

Stimulation of the verumontanum produces peristalsis of the vas deferens and when this structure is irritated, erections will often result. It becomes congested during erection and coitus. This congestion and swelling during coitus is not, however, the causative factor in preventing the semen from passing into the bladder upon ejaculation. The spasm of the bladder sphincter and urethral muscle creates the barrier in the posterior urethra.

GLANDS

Cowper's Glands These structures produce a secretion which lubricates the urethra during erection and coitus, preparing the path for the semen by the mere lubrication and alkalinization of the urethral mucosa, which has been in contact with the acid urine. Upon erection, this secretion, together with that of the urethral glands, often presents itself at the meatus.

Urethral Glands They also lubricate the urethra and add to the secretion of Cowper's glands. Although freely and readily infected and often the seat of stubborn chronic gonorrhea, these glands protect the urethra against infection and help to combat it.

THE PENIS

This is the organ of copulation, proper erection of which is necessary for satisfactory coitus. It has secreting glands (preputial) at the corona, which produce the smegma that collects here. The skin over the penis is thin and loose and is abundantly supplied with nerves. The glans penis is a very sensitive structure, irritation of which produces erection. During erection, the penis is somewhat flattened and slightly bent to accommodate the vagina.

The Mechanism of Erection Erection is due to an active hyperemia of the corpora cavernosa and the corpus spongiosum as the result of stimulation of the vasodilators. Due to the tension within the blood-filled cavernous bodies, there is some interference with the venous return flow which helps maintain the erection. The stimulus for erection arises mostly from the brain, the desire for libido being stimulated by various causes. The erection center in the spinal cord is in the lower sacral cord and is under the influence and control of the cerebral centers. It can also be stimulated reflexly by peripheral stimuli, such as irritation of the body or glans penis—the latter being well supplied with end nerves. The congested prostate and vesicles also reflexly stimulate the spinal erection center. The internal secretion of the testicle is also a factor as are probably also the interrelated endocrines of the adrenal cortex, thyroid and pituitary. Morning erections due to a distended bladder are probably due to a congestion of the prostatic plexus and are to a large extent, merely passive congestion.

The Mechanism of Ejaculation The center for ejaculation is separate from that of erection and is in the upper lumbar cord. During ejaculation, aside from the contraction of the unstriated muscle of the vesicles, prostate and urethra, there is also a clonic contraction of the bulbo-cavernosus, ischio-cavernosus and all of the perineal muscles (Fig. 55) which give the expulsive force to this act. It is evident

that complete coordination exists between the erection and ejaculatory centers during the act of coitus and that at the proper time when the erection center is overloaded with stimuli, reflex stimuli are referred through a reflex arc to the ejaculatory center producing the orgasm and ejaculation

THE SEMEN

The semen consists of the product of the secretion of the seminiferous tubules—the spermatozoa together with the secretions of all the accessory sex glands and ducts and the urethral glands. Under normal conditions in the vigorous male having coitus at proper intervals the quantity of semen with each ejaculation averages about 2 cc. Only 10 per cent of this consists of spermatozoa which vary considerably in number depending on the quantity of semen and the frequency of coitus. The average number of spermatozoa with each ejaculation is 50 to 200 million. The semen is a thick sticky substance having a peculiar odor (see above) derived from the prostate. It becomes fluid very rapidly upon exposure to air. It is alkaline and all of the secretions from the various structures making up the bulk of the semen are alkaline. It contains nucleo-proteins, globulins from the vesicles and also mucin, lecithin and cholesterol. Prostatic crystals are sometimes seen in large numbers and spermin crystals and spermine are found in the residue. What the function of the latter may be has not been determined.

THE SPERMATOZOA

Their motility and appearance, together with the presence of extraneous substances such as pus and blood and excessive mucus are the indications of fertility. They can be kept alive on a slide with the air excluded for a period of 24 to 48 hours. About 10 per cent are found normally to be non motile on the slide. Only one spermatozoon is necessary to fertilize the ovum. The spermatozoon has a head, in which its nucleus rests, a neck and a tail which latter is about three times as long as the body and neck. It derives its motility from the movements of the tail. The tail and neck disappear when it impregnates the ovum. The spermatozoon is about one five-hundredths of an inch long. It is more likely that determination of sex exists in the primary germ cell and is dependent upon the number of chromosomes present. Spermatogenesis does not begin until puberty and is not fully developed until a few years later. In old age the number and quality of the sperm gradually diminishes although they may be found in men of 75 and 80.

CHAPTER 4

UROLOGIC INSTRUMENTS¹

SCALES
URETHRAL INSTRUMENTS
CATHETERS
URETHRAL BOUGIES
URETHRAL SOUNDS

URETERAL INSTRUMENTS
URETERAL CATHETERS
SYRINGES
IRRIGATORS (PERCOLATORS)
FORMALIN STERILIZERS AND CABINETS

The beginner in urology is confronted with a large number of instruments, etc which are usually unfamiliar even though he has had a course in general surgery

A working knowledge of the more commonly employed instruments is essential to the diagnosis and treatment of the various conditions which modern urology includes

SCALES

An often confusing problem is to become familiar with the scales according to which the various catheters, etc, are numbered (calibrated) One still finds a few sounds and catheters marked with the American, English and French numbers The majority of urologists both abroad and in this country prefer, however, the French systems of measurements There are two of these (a) the Charriere scale and (b) the Beniqué scale The former (Charriere) expresses its measurement in one-third of a millimeter diameters, thus No 5 (Fig 65) indicates a diameter of $1\frac{2}{3}$ mm Thus it is easy to determine the diameter by dividing the number of the instrument by three Many French makers of urologic instruments have recently adopted the Benique or Pasteau scale instead of the older Charriere According to this Beniqué or Pasteau scale, the number on the catheter, bougie, etc is double that of the same instrument in the Charriere, e g a No 10 ureteral catheter on the Benique scale is the same as the No 5 on the Charriere The chief advantage in using the Beniqué scale is that it is more flexible when one wishes to use numbers which are halfway between two of the older Charriere ones, e g Beniqué sounds (Fig 77) are to be purchased in both half and full number sizes, e g a No 49 Benique sound would really be a No $24\frac{1}{2}$ Charriere but No 49 is an easier number to work with, than the more cumbersome one of $24\frac{1}{2}$ Most urologists, however, employ the Charriere scale This scale is usually meant when reference is made to the French scale

The American scale is rarely used at present even by our own instrument makers It measures in half millimeters to indicate its diameter Its numbers equal two-thirds of the French, e g 20 American equals 30 French (Charriere) etc

The English scale is still employed by many London instrument makers, but the French scale is very much used by English urologists especially in speaking of ureteral catheters, bougies, etc because nearly all of the latter are of French manufacture

Many soft rubber urethral catheters still carry the English system of measurement The following are those most employed in this country with the corresponding French numbers

¹ We are indebted to Mr George W Wallerich of V Mueller and Co, Chicago, for valuable assistance in the preparation of this chapter

No 5	English equals	No 8	French (Charriere)
No 7	'	12	'
No 8	'	14	"
No 9		16	
No 10		" 18	

Having attempted to clear up this question of calibration of instruments, let us take them up in detail

Abbreviations for Scales F behind the number indicates the French Charriere scale. The Beniqué newer system of numbering is double the ordinary F. The letters Am indicate American and E the English system of measurements

URETHRAL INSTRUMENTS

CATHETERS

A. Rubber catheters usually referred to as Nelaton soft rubber. The following are most frequently used in the male (see Fig 66 and Fig 67)

1 SOLID TIP Those with a solid tip and one or more eyes (openings) in close proximity to the tip. These are the most commonly used of the soft, i.e. pure rubber variety for catheterizing male patients

2 HOLLOW TIP Those with a hollow tip (Wishard catheters) with one or more eyes (openings) near the end. They are very often used with a mandrin (Fig 70) for cases e.g. of urethral strictures in which the ordinary solid tipped catheter cannot be passed

3 OPENING AT END Those with an opening at the end of the catheter and one or more just distal to it. These are very useful when one wishes to use an inlying catheter in draining a bladder

4 AN ELBOWED OR COUDÉ CATHETER. These have been manufactured recently of rubber, so that they can be entrusted to patients who are obliged to catheterize themselves because they can be sterilized by boiling and are very useful in catheterizing cases of obstruction at the bladder neck due to prostatic adenoma, etc.

5 OLIVARY TIPPED rubber catheters. These are also a comparatively recent addition to our armamentarium and have the same advantages as the coudé (or

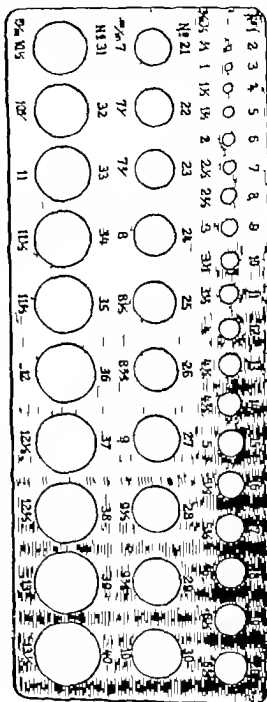


FIG. 65.—Catheter scale.

elbow) rubber catheters They can be used by patients with urethral strictures who have chronic urinary retention not relieved by operation, dilatation, etc because they can also be sterilized by boiling In addition they are convenient for office or hospital practice in catheterizing cases of urethral stricture or contractures and similar vesical neck obstructions

CHOICE OF SIZES IN RUBBER CATHETERS For children and young adults (male and female) the smaller sizes, viz 8 to 12 F, i e 5 to 7 English For adults of both



FIG 66—Soft rubber (Nelaton) urethral catheter

sexes, it is also advisable to use small sizes, viz 12 F (7 English) or 14 F (8 English) rather than a 16 F (9 English)

B Rubber Catheters for Use in the Female One can, of course, employ any one of the first three catheters described above as designed for males, but we

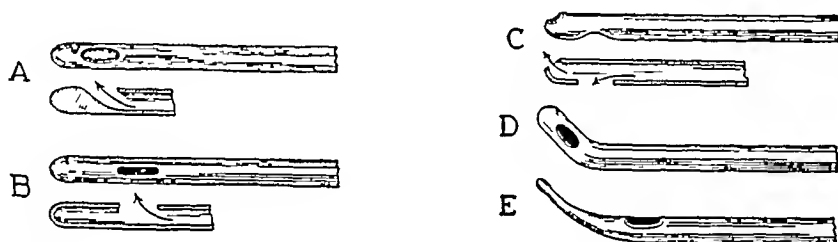


FIG 67—Diagrammatic representation of exterior, combined with sectional views of the different types of rubber urethral catheters

- A Ordinary Nelaton, with solid tip and one or more lateral openings
- B Wishard's hollow tip catheter which can be easily threaded over a mandrin
- C Open end catheter Very useful as an inlying catheter in the male There is an opening at the tip of the catheter and one or more lateral openings close to the tip
- D Rubber catheter with coude tip
- E Same with olivary tip

prefer a special, much shorter one for catheterization of the female bladder These shorter rubber ones can be purchased either with the solid tip (Fig 68) or with an opening at the end We prefer the former For use as an "inlying" catheter in the female, a Pezzar (Fig 70) or a Malecot two or four wing (Fig 69) self-retaining catheter, is superior to all others It can be best introduced when stretched on a mandrin (Fig 71)



FIG 68—Closed (to left) and open (to right) Soft rubber short catheters for use in females

Metal catheters are employed far less frequently for females than formerly Glass catheters should be entirely discarded as instruments for catheterizing the female bladder, because of the danger of breaking them

C Ordinary Woven Silk Catheters These have the disadvantage of being much more difficult to sterilize Until recently it was only possible to do so either by formalin (see Fig 90) or by immersion for ten minutes in a 1-5000 solution of biniodide of mercury Recently an effort is being made by some French manufacturers to devise a woven silk catheter which can be sterilized by boiling

The great advantage of these silkwoven catheters (and the same is true of

urethral bougies) is that they possess greater flexibility than metal and yet more rigidity than rubber catheters

The principal types of woven silk urethral catheters³ are (Fig 71)

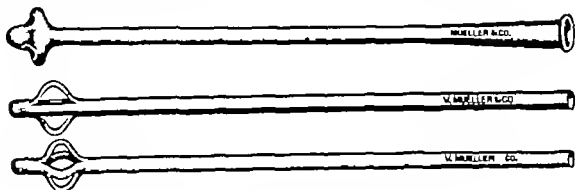


FIG. 69.—Retention catheters (soft rubber) for use in females and also suprapubic drainage. For the latter they are now made in right angle form.

- 1 BLUNT Those with a blunt i.e. cylindrical tip
- 2 OLIVARY TIP Those with an olivary tip These are very useful, especially when of narrow caliber in passing through a stricture of the urethra



FIG. 70.—Mandrin for use with hollow tip soft rubber urethral catheters (see Figs. 75 and 113)

- 3 ELBOW Those with an elbow or coude tip Indispensable for catheterization of cases of prostatic adenoma The angle which the elbow forms with the shaft varies in these catheters from 25 to 35 degrees

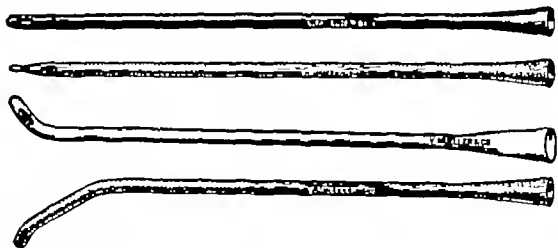


FIG. 71.—Silk woven urethral catheters of cylindric, olivary, coudé and double coudé types (from above downwards)

- 4 DOUBLE ELBOW Those with a double elbow or coudé tip Also very useful for difficult cases of bladder neck obstruction

Examination of all woven silk urethral catheters, bougies, and even of ureteral catheters should be made at frequent intervals. They are made of woven silk, cotton or linen and afterwards varnished. As the result of drying or of the necessary manipulations the varnish will crack in course of time thus admitting moisture after which they deteriorate rapidly. The various methods of sterilization also favor destruction and subsequent cracking of the varnish.

SIZES As in the case of soft rubber catheters, the smaller sizes are preferable, e g for the average male adult, a size 16 to 18 F especially in the olivary and coudé varieties of woven silk catheters

D Metal Urethral Catheters (Fig 72) These are employed when the rubber (soft) and woven silk varieties have not been successful in entering the bladder Every urologist's office or hospital service should possess three varieties of metal catheters viz

1 **VAN BUREN CURVE** Those with the Van Buren curve An assortment of sizes should include those for use in children, e g 8 to 10 French (Charriere) to those for use in adults

2 **BENIQUE CURVE** Those with the Benique curve Very useful in catheterizing cases of obstruction at the bladder neck due to prostatic adenoma

3 **TYPICAL ELBOW** Those with a typical elbow or coudé tip At times these will be found invaluable for catheterization of difficult cases

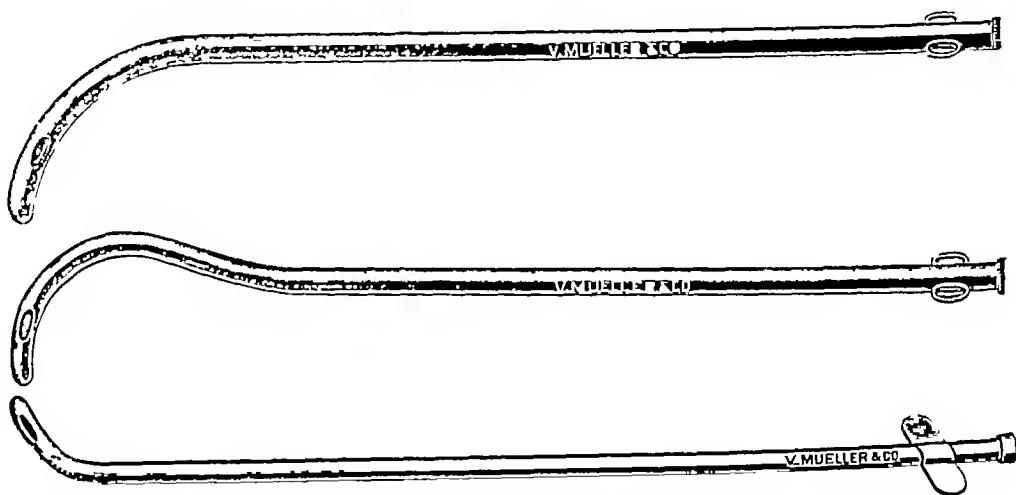


FIG 72—Metal urethral catheters of Van Buren curve, Beniqué curve and Coude curve types (from above downwards)

Like rubber catheters, all of these metal catheters can be sterilized by boiling

SIZES One should have a small size (8 F) metal catheter at hand for use in children For adults we also prefer the smaller sizes e g 12-14-16 F

E Follow-Up Catheter At times, one encounters cases of urethral stricture with greatly distended bladders in which the various types of catheters previously described, fail In some of these almost impermeable strictures, it will often be possible to introduce a filiform woven silk or whalebone filiform bougie through the narrow lumen and allow the urine to escape alongside of the bougie so as to empty the bladder gradually

If it becomes desirable, however, to evacuate the bladder contents in larger amounts than is possible by the use of a filiform alone, the woven silk variety can be used in conjunction with a follow-up catheter to which it can be connected There are two types (Fig 73) of such follow-up catheters (a) a complete silk woven one (Phillips) and one (b) in which the catheter itself is metallic, but the filiform guide is of woven silk manufacture This latter variety termed a "LeFort" follow-up catheter (Fig 73) is to be preferred because the metal portion can be easily sterilized i e by boiling One should have on hand at least six woven silk

filiform guides or bougies which can be screwed on to the catheter portion. Of the latter at least two sizes 14 and 16 F (Charriere) should be available

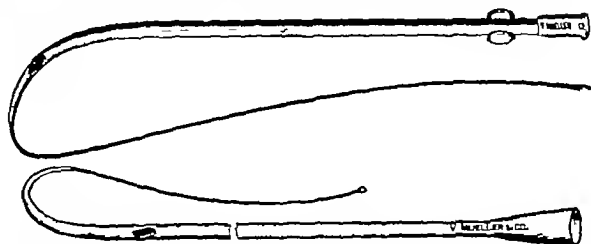


FIG 73.—Followup catheters. Upper—shows LeFort type with metal shaft and woven silk filiform tip which is screwed to shaft. Lower—Phillips woven silk followup catheter. Filiform tip is continuation of shaft.

URETHRAL BOUGIES

1 **Bulbous bougies** (Fig 74), silkworm or metal are used for exploration of the urethra for a possible stricture. Of the silk woven variety those with an olivary tip at one end and an acorn shaped tip at the other end (Top of Fig 74) are

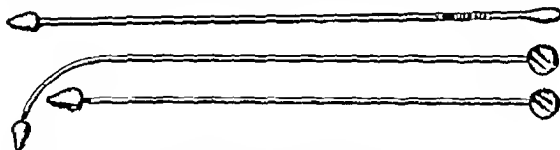


FIG. 74.—Bulbous bougies. Top Woven silk. Middle. Curved metallic. Bottom. Straight metallic. The woven silk is most commonly employed.

preferable. Olivary ended metal bougies (Fig 74) are not as flexible as those of woven silk but are preferred by some urologists

SIZES It is advisable to have an assortment from 8 to 25 F

2 **Whalebone Filiform Bougies.** (Fig 75) These are invaluable in the

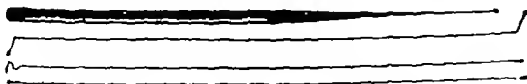


FIG 75.—Filiform (whalebone) bougies of tapering bayonet spiral and straight types.

examination of urethral strictures. There are three forms (a) straight, (b) bayonet i.e. with a bayonet like end and (c) corkscrew i.e. those with a spiral end to pass through the tortuous channel of some strictures and (d) the long tapering Banks bougie.

3 **Silkwoven Bougies** These vary in size from one just beyond that of

the whalebone filiform i.e. about 2 French to large ones (size 26) As will be referred to in the chapter on Urethral Strictures, one seldom employs bougies above size 22 F (abbreviation for French Charriere scale) for purposes of dilatation There are two varieties (Fig 76) (a) those with tapering tip, and (b) those with olivary tip Both of these varieties of bougies are most often employed up to size 22 F as just explained One has little occasion today to use the silk woven bougies filled with lead In some cases of stricture one can enter the narrowed area of the urethra more easily with a bougie from size 20 to 26 F inclusive than with the same sized sound, hence it is well to have some at hand, as large as 26 F to 28 F

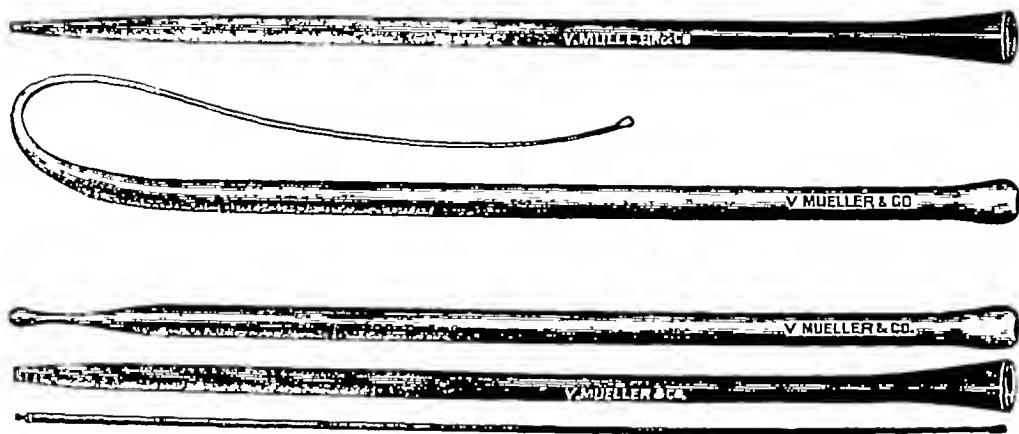


FIG 76—Silk woven bougies of tapering, olivary and filiform types Of the latter (Phillips bougie) there are two varieties, one with detachable (bottom illustration), and the other with nondetachable tip

4 Follow-up Bougies These are constructed on the same principle as the corresponding type of catheters and are very useful in beginning the treatment of strictures by gradual dilatation The filiform guide either is continuous or can be screwed on to the shaft of the “follow-up” portion

URETHRAL SOUNDS

1 Ordinary Metal Sounds (Fig 77) There are two principal types of ordinary curved sounds

- (a) VAN BUREN CURVE Those with a Van Buren curve
- (b) BENIQUE CURVE Those with a Benique curve
- (c) THE WALTHER SOUND (Fig 78)

The first named is still preferred by a few urologists, but the Beniqué type is gradually supplanting the other, for the reason that it more accurately follows the curve of the posterior urethra and is therefore easier to introduce after its tip has penetrated the anterior layer of the triangular ligament Some prefer a cylindrical tip, while others like a more tapering one

2 Follow-up Metal Sounds with Filiform (woven silk) Guides (Fig 79) These are very useful in the treatment of urethral stricture by gradual dilatation The filiform silk woven detachable guide can be passed through the narrowed portion of the urethra into the bladder and then screwed to the sound proper, and the latter then follows the guide through the strictured area into the bladder Before a follow-up catheter, bougie, or sound is used, one must always be sure that the filiform guide fits accurately and that it is in good condition, i.e. not too

old and liable to be broken close to its base where it is fitted by a screw end to the catheter bougie or sound⁴

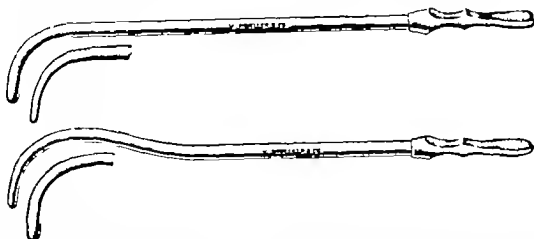


FIG. 77—Ordinary urethral (metal) sounds. Upper shows Van Buren curve, the tip can be blunt or tapering. Lower is of Beniqué type curve with a tapering tip and also one into which a filiform guide can be screwed. The ordinary tapering tip Beniqué is commonly used.

The use of such follow up urethral instruments cannot be too warmly recommended because much unnecessary trauma to the urethra is avoidable through familiarity with the principle upon which they are constructed.

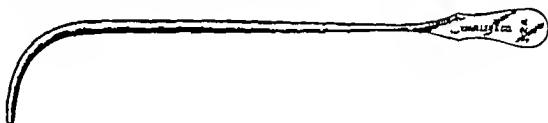


FIG. 78—Walther urethral sound, tapered toward the handle.

In many of the French urological clinics all sounds now employed are of the follow up type with a Beniqué curve and a cylindrical tip.

3 Straight Urethral Sounds. There are two varieties.



FIG. 79—LeFort follow up sound.

(a) **SHORT STRAIGHT SOUNDS** (Fig. 80) for dilatation in men who have such a narrow external meatus that the passage of a sound, cystoscope, etc. above size

Both urethral and ureteral silk woven catheters should have a dry lumen (free from water) before being sterilized by formaldehyde vapor. The latter is prevented from penetrating into every crevice when water coats the interior of the catheter. The lumen may be dried by compressed air or by using a formaldehyde sterilizer so made that the freshly generated gas must first pass through the lumen of the catheter.

16-18 F, is very painful. These short urethral straight sounds are also very useful in dilatation of the external meatus and urethra, in women who have strictures at either of these points.

(b) LONG STRAIGHT SOUNDS for dilating the anterior urethra alone especially when combined with massage, in the treatment of chronic anterior urethritis.⁵

URETERAL INSTRUMENTS

We will only direct attention to ureteral catheters at this time because the various types of other ureteral instruments can be more satisfactorily taken up in connection with the special subjects of ureteral calculi, strictures, etc.

URETERAL CATHETERS

These are much longer than the corresponding urethral instruments, usually about 65 centimeters. They are all of the silk woven variety but differ in this respect, that in the so-called "plain" or nonopaque type, the silk is simply covered with plain varnish, while in the other type,

FIG 80

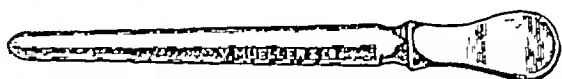


FIG 80—Short steel sound for measurement or dilatation of external meatus in males and females

FIG 81

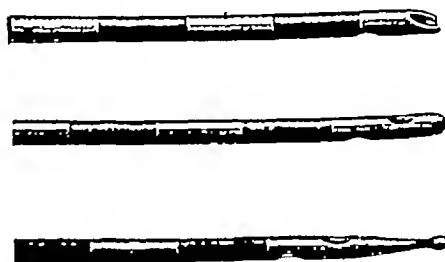


FIG 81—Ureteral catheter tips of the flute, cylindric and olivary varieties (from above downwards)

called opaque (or x-ray or shadowgraph) catheters, there is in addition, a coating with some chemical, like barium, which is opaque to the x-ray.

Aside from this property of being capable of casting a shadow there is no difference between the plain and opaque types, except in regard to the question of expense. The nonopaque are much less costly but are only utilizable when one does not wish to ascertain the relation of the ureter or kidney to a given shadow or study the course of the ureter, i.e. whether or not it is displaced by a tumor, etc. The nonopaque type is very often employed in lavage of the renal pelvis. The principal feature about ureteral catheters is as to (a) whether they are graduated or not into divisions of 1 cm. each (Fig 81) and (b) as to the tips. There are three principal forms (Fig 81) of the latter:

- 1 A WHISTLE TIP, i.e. an opening at the end and one near it on the side.
- 2 A CYLINDRICAL TIP, i.e. closed at the end, but with one or more openings near it.
- 3 AN OLIVARY TIP, i.e. a tapering tip with an opening just behind the point of narrowing.

One ought to have an assortment of ureteral catheters in which all three of these forms of tips are represented. The whistle or flute tip is most frequently used and should constitute the major portion of our stock, but at times when it is

⁵ Sizes of sounds. One should have an assortment of half sizes from 40 F (Benique). The majority of manufacturers now have this assortment in a special container.

impossible to insert a tip of this kind through a ureteral orifice or any distance up the ureter itself one of the other forms of tips will often be successful, especially the olivary form

In regard to sizes it is advisable for ordinary ureteral catheterization in children to use 4-5 F (Charriere) i.e. 9 or 10 F (Beniqué) In adults we seldom use a size larger than 5 F (Charriere) because a smaller size cystoscope (21 F Charriere) is preferable and one cannot use two catheters larger than No. 5 F or 5½ (11 Pasteau) if this size of instrument is to be withdrawn and the catheters left in situ while the urine is being collected or radiographic exposures made



FIG. 82—Olive tip ureteral bougie, non-graduated, made in sizes 3-14 French.

When one is accustomed to use larger cystoscopes i.e. from 22 to 26 F size then 5½ F (11 Pasteau or Beniqué or 6 F (12 Beniqué) are preferable

For ureteral dilatation we prefer the olive tip ureteral bougie (Fig. 82) in sizes from 6 to 14 French

SYRINGES

1 Luer This has both a glass barrel and piston (Fig. 83) and receives its name from the French instrument maker who designed it. The most commonly employed sizes are those which hold 2, 5, 10 and 20 cc. respectively. They can be purchased with a central or eccentric tip. The latter have slight advantages when the syringe is used for intravenous injections or for local anesthesia. We prefer this type of 'all glass' syringe for office and hospital routine work, because they require less care than the older syringes with leather metal or similar plungers or pistons. Through the application of an adapter (Fig. 84) the Luer syringe can be made interchangeable for either needles which fit this type or the Record syringe

FIG. 83

FIG. 84

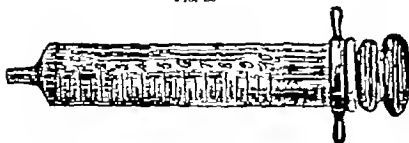


FIG. 83—10 cc. Luer syringe.

FIG. 84—Adapter to be employed in use of Record needles on Luer syringe

2 Record Syringe This is an ideal syringe for local and regional anesthesia work because the needle fits on the metal tip more accurately than is possible with the glass tip of the Luer syringes. The most convenient size to use is 10 cc. (Fig. 85). The syringe is part metal and part glass and care must be exercised in the sterilization of the syringe by boiling. The cylinder or barrel must be separated from the metal piston or plunger and both placed in cold water which is gradually brought to the boiling point and remains so for ten minutes. One must wait until both barrel and plunger are cooled off before putting them together lest the

difference in coefficient of expansion and contraction of the glass and metal portions result in a cracking of the former

We greatly prefer the Lundy (Fig 80) or metal tip Luer or similar types of syringes to the Record, for sacral block (See Chapter 4) and paravertebral anes-

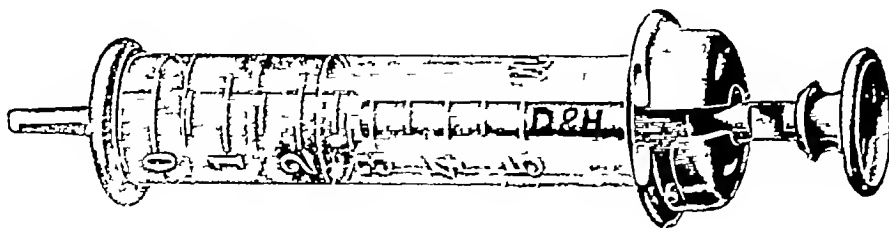


FIG 85—10 cc Record syringe

thesia There is a special advantage in using the bayonet method of locking the needles to the barrel of the syringe, because in the Record type one cannot obtain as good a water tight connection between needle and syringe tip

Much of the question of success or failure in such work depends upon the needles which one employs, rather than the type of syringe, and we are selecting needles of much finer caliber than earlier in our experience

3 Rubber Bulb Glass Barrel Syringes These have practically supplanted the older piston syringes, both of the smaller size (with glass handled plungers and asbestos or similar packing)

There are two chief forms

(a) Those with a barrel holding from 50 to 120 cc and a narrow tip (Fig 87) which can be easily inserted into the expanded distal end of a urethral catheter By regulating the compression of the rubber bulb, the barrel can be as slowly or rapidly emptied as was the case with the older piston syringes They can be easily sterilized by boiling and are less likely to get out of order than was the case with the piston type We prefer this bulb syringe for bladder irrigation because as will be shown later, an injection of one to three ounces at a time accomplishes as much as allowing the bladder to fill from an irrigator and is far less painful, in the majority of cases of cystitis

(b) The second type of bulb syringe differs only in respect to its tip We prefer one with a blunt rubber cap (Fig 88) which can be slipped over the tip, to the type with the conical glass end This form of bulb syringe is ideal for anterior urethral injections as well

as for those in chronic posterior urethritis, in which one desires to irrigate the entire length of the urethral canal, without introducing an instrument into the lumen These syringes of smaller size, say 15 to 30 cc, can be safely entrusted to patients for anterior instillations in acute urethritis

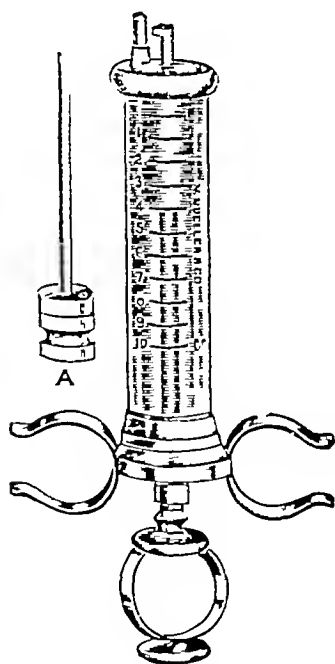


FIG 86—Lundy 10 cc syringe, with open rings to facilitate ease of handling syringe and with metal pad on thumb ring for additional pressure with palm of hand when required

IRRIGATORS (PERCOLATORS)

These are employed for irrigation of the anterior urethra (Fig 90), for filling of the bladder in cystoscopy and other purposes. One should be selected which

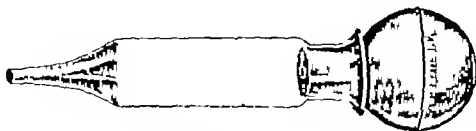


FIG. 87.—Large size (120 cc.) asepto syringe

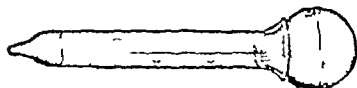


FIG. 88.—Rubber bulb glass barrel syringe with removable rubber tip

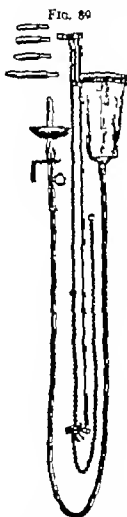


FIG. 89

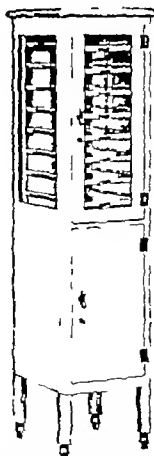


FIG. 90

FIG. 89.—Valentine irrigator with various urethral tips.

FIG. 90.—Formalin sterilizer for cystoscopes, silk woven catheters and bougies.

has a capacity of 1000 cc. and in which the glass percolator is graduated and can be easily lowered or raised.

FORMALIN STERILIZERS AND CABINETS

For those urologic instruments which cannot be sterilized by boiling, one of the two following methods remains. Silk woven urethral catheters, bougies, filiform guides, etc., as well as urethroscopes and cystoscopes can be placed on the shelves of cabinets which are constructed so that the instruments are surrounded by formaldehyde gas. These cabinets are ideal in many respects but such instruments require twenty-four hours for sterilization (Fig 90)

To shorten this to a period of two hours many of the larger French clinics now use special sterilizers in which the formalin crystals are more rapidly evaporated with the aid of heat supplied by an electric bulb. The size of these quicker acting formalin sterilizers depends upon the length of the instruments and the work of the clinic. Although the time element has been overcome by these special sterilizers, the same objection remains, viz., that the silk woven instruments covered as they are by varnish, soon become rough. In our work we now employ a 1-5000 solution of biniodide of mercury for both silk woven instruments and for cystoscopes. After use, both are washed thoroughly with soap and water and before using again are immersed for ten minutes in this solution which has the additional advantage of not corroding metal. The tendency at present is to improve the manufacture of woven silk urethral instruments so that they can be sterilized by boiling which many of us are already doing today with ureteral catheters and bougies. An effort is also being made to construct cystoscopes which can be sterilized by boiling.

CHAPTER 5

MINOR OFFICE TECHNIC

ROUTINE OFFICE EXAMINATION

EXTERNAL

EXAMINATION OF THE GENITALIA

TAKING THE SMEAR

INTERNAL

RECTAL EXAMINATION

PALPATION OF THE PROSTATE

PALPATION OF SEMINAL VESICLES

MASSAGE OF THE PROSTATE

MASSAGE OF THE CONTENTS OF THE

SEMINAL VESICLES

MASSAGE OF COWPER'S GLANDS

MANUAL PALPATION OF THE VESICLES

TREATMENT

PASSAGE OF A SOUND

PASSAGE OF A CATHETER

INSTILLATION IRRIGATION AND INJECTION

ROUTINE OFFICE EXAMINATION

The routine office examination (except for contraindications in acute gonorrhea and analogous inflammatory and suppurative conditions in the urethra prostate and vesicles and bladder) is as follows

- 1 Examination of the external genitalia
- 2 Examination of smear
- 3 Two glass test.
- 4 Prostatic and vesicle massage Passage of remaining urine etc. into third glass.
- 5 Examination of secretions of prostate and vesicles
- 6 Passage of diagnostic and ordinary bougies and metal sounds for determining strictures and infiltrations
- 7 Urethroscopy

EXTERNAL EXAMINATION

Examination of the Genitalia. In a routine examination, the contents of the scrotum should be palpated (Fig 91) Presence of an induration at the tail of the epididymis indicates an old epididymus Cysts at the head of the epididymis that would otherwise be overlooked can often be felt The infiltration of the urethra can be noted in acute gonorrhea by the pipestem hardness of the urethra and chronic infiltrations can often be felt (Fig 92) Palpation may reveal an infiltrated dorsal lymph cord (Fig 54) and adenopathies Lesions over a phimosis and discharge therefrom can also be observed The appearance of the meatus whether edematous, red, lips everted or discolored is of considerable importance.

Taking of Smear If the discharge is profuse do not take the first drop This often contains degenerated leukocytes and only a few organisms The discharge which has dried about the meatus should be cleaned off and the glans penis should be washed The patient should if possible retain his urine for two hours before a smear is taken Do not take the smear if the patient has not urinated since his last injection the antiseptic still remaining will destroy the organisms in the discharge In taking a smear evert the lips of the meatus and with thumb and forefinger of the other hand (Fig 93) milk out the discharge from the first one or two inches of the urethra With a platinum loop or a cotton applicator the pus is picked up (Fig 93) and deposited on a slide The smear is now spread out with another slide to make it thin. A thick smear is often of very little or no value

IN THE FEMALE, a smear is taken from the cervix and urethra (Fig 93) With a speculum in place, the vaginal and cervical secretions are first cleaned out, then with an applicator, some secretion is removed from the cervix and spread on a slide In taking a smear from the female urethra, the urethra is



FIG 91—Differential diagnosis by palpation of hydrocele of tunica vaginalis from reducible inguinal hernia In hydrocele, one can grasp above (see illustration) upper end of tumor while in hernia the swelling continues into inguinal canal so that its upper border cannot be grasped

massaged forward with the index finger of the left hand, expressing the pus in Skene's ducts and a smear is taken as from the cervix If there is no discharge at the meatus in the male upon inspection, expression of the first inch or two

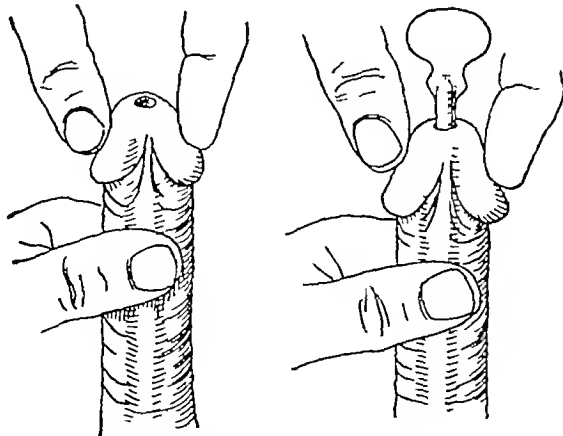


FIG 92 —Palpation of urethra without and with aid of sound (after Papin) for areas of induration (periurethral folliculitis, etc)

of the urethra will often show it, for pus usually accumulates in the fossa navicularis

Milking of the male urethra is often necessary to bring out the discharge at the meatus The left hand is placed on the dorsum of the penis at the pubis

and the right is back of the scrotoperineal junction. The urethra is now milked forward for a distance and then the hands move further up milking the pendulous urethra. One will often be surprised to find enough discharge at least for a

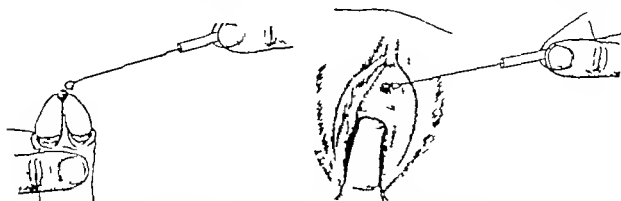


FIG. 93.—The illustration on the left shows how to take a smear from the urethra in the male, while that on the right shows same method in the female

smear. With a sound in the urethra, massaging over it (Fig. 100) will usually bring out a fair amount of discharge from the crypts and glands for examination.

FIG. 94

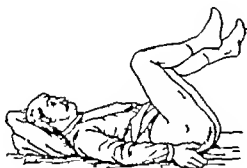


FIG. 95



FIG. 96



FIG. 94.—Dorsal position for palpation of prostate, seminal vesicles and Intervascular area (Papin) (Compare with Figs. 95 and 96)

FIG. 95.—One of the positions used for palpation of prostate, vesicles, Intervascular area and massage of prostate (Papin) (Compare with Figs. 94 and 96)

FIG. 96.—One of the positions used for rectal palpation of prostate, Intervascular area and seminal vesicles. (Compare with Figs. 94 and 95)

INTERNAL EXAMINATION

Rectal Examination. Digital exploration (Figs. 94, 95 and 96) within the rectum is an important and very valuable routine procedure. Rectal examination in the male is equally as important as vaginal examination in the female.

The diagnosis is often made here, for pathology in the prostate and vesicles is frequently the cause of sacral and lumbar pain. Pain in the lower abdomen and inguinal regions is often due to infections of the prostate and vesicles and these should be searched for. Every routine examination for genital or urinary disturbance in the male, requires a rectal examination also. Backache in the male is an indication for rectal examination.

Palpation of the Prostate With experience, after having examined a few cases, the clinician is better able to determine what he feels. The prostate usually is found about one-half or three-fourths of an inch above the anus. Normally it is rounded, even and smooth and the two lateral lobes and groove can be distinctly felt. There are great variations in size and to a certain extent, in consistency. Irregularities can be noted, involvement of one or more lobes, difference in the relative size and consistency of these lobes (whether congested) and the presence of fluctuation of an abscess can be noted. The enlargement of a prostatic hypertrophy, the stony hardness of cancer of the prostate and prostatic calculi can all be felt.

FIG 97

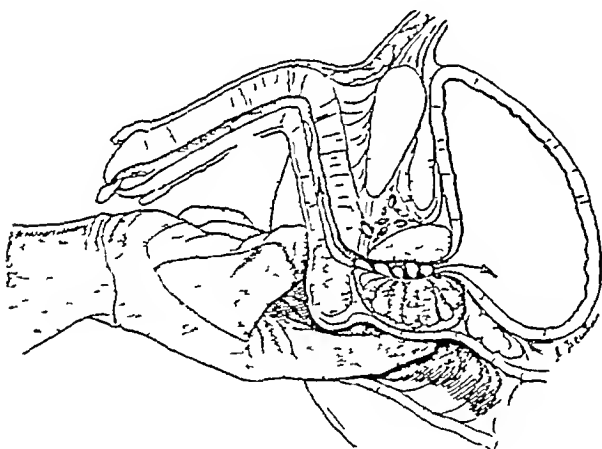


FIG 98

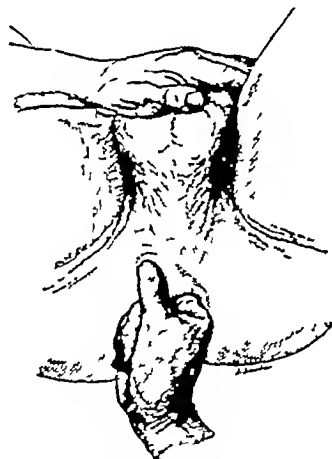


FIG 97—Diagrammatic representation of how massage of prostate acts (Papin)
 FIG 98—Method of palpation of Cowper's glands (Papin)

Position of the Patient for Examination of Prostate and Vesicles (Figs 94-97 incl) 'Any one of three positions can be employed. The most satisfactory for the patient is that he lie on his right side with the clinician facing the patient. The index finger of the right hand should be employed. Some patients react poorly to massage of the prostate (Fig 97) and vesicles, some may even suffer syncope and in a lateral position the danger of falling off the table is not very great. However, with the patient on the side, even with knees bent up it may be difficult to examine and massage the left lobe of the prostate and the left seminal vesicle.

A second position is that of the patient leaning over a table or stooping over. This is often satisfactory but is also quite difficult for the patient.

A third position is the knee-chest position on a table. With the patient in this position the index finger, which is always used, can be inserted higher up than in any other position, for not only is it necessary to examine and massage the prostate, but also the seminal vesicles.

In massaging and examining individuals with large buttocks, insertion of the finger high up into the rectum is often difficult, but is usually accomplished with the patient in knee-chest position. The various metal instruments for insertion high up into the rectum to aid massage of the vesicles and for diagnosis are of no value and may be harmful. Palpation with the finger is the only certain way of establishing any findings.

Palpation of the Seminal Vesicles. These are not palpable normally in most individuals. In some, the vesicles are quite distended and atonic and can be felt. In others who have not had coitus for some time they can also be felt and in men suffering with acute gonorrhea this is often the case and should not be mistaken for pathology. The vesicles lie at an angle of 30-45 degrees (Fig 37) above each lobe of the prostate and the finger must be inserted above the prostate for their examination. Many physicians and urologists never insert the finger above the prostate. The seminal vesicles are more important than the prostate from the standpoint of gonorrheal infection. They should always be examined. Thickening and induration due to perivesiculitis can easily be determined. The ampulla of the vas can often be felt if thickened. Occasionally the thickened and infiltrated tuberculous ureter can be felt per rectum. Infiltration at the bladder neck, trigone, and pelvic cellulitis can be determined and sometimes even a pelvic abscess can be found.

Massage of the Prostate. Beginning with the upper pole, with a rotary motion and not too much pressure the prostatic lobe on each side is massaged downwards toward the median line (Fig 97). Massage of both prostate and vesicles should take about thirty seconds; more time is not desirable. Following fairly active massage a drop usually appears at the meatus to be used for microscopic examination of the secretion. Massage of the prostate and vesicles is part of the routine three glass test. The patient urinates in two glasses; more in the first, and retains some urine in the bladder and then urinates after the massage. The first glass shows the pus from the anterior urethra; the second, that from the posterior urethra or further back; and the third, the prostatic and vesicle secretions. Some urologists fill up the bladder with a mild antiseptic preliminary to massage in order to make the prostate, seminal vesicles and bladder neck more prominent for examination and massage, but this is not necessary.

Massage of the Contents of the Seminal Vesicles. Massage of both the prostate and seminal vesicles causes a slight amount of pain; normally marked pain over the seminal vesicle is indicative of pathology. For stripping the seminal vesicles, the finger is carried high up at an angle above the prostate and presses downward and forward toward the median line on each side. Very often the expressed material is found at the meatus, where enough for a slide can be obtained.

The urine in the third glass following prostatic massage shows a peculiar hazy opalescent or milky appearance that is characteristic. Casts or shreds from the seminal vesicles are long and thin, being moulded during passage through the ejaculatory ducts. Evidence of pus can in most cases be determined by gross examination of the sediment.

Massage of Cowper's Glands. (Fig 98) With the patient lying on his back, the finger is inserted into the rectum and in front of the prostate and massaged forward with the left hand pressing on the perineum on each side.

Bimanual Palpation of the Vesicles In thin people with somewhat relaxed abdominal muscles the left hand is placed above the pubis, with the right index finger in the rectum, the patient being in knee-chest position. Very often both hand and finger come together with the vesicle in between.

TREATMENT

PASSAGE OF A SOUND

Palpation of the urethra over a sound (Fig 92) This gives valuable information, often more reliable than the urethroscope. Periurethral infiltration can readily be felt. Bands of scar tissue or stricture in the pendulous urethra can easily be noted. Massage of the urethra over a sound in cases of periurethritis or periurethral abscess will often be followed by opening and drainage into the urethra.

Passage of a Sound In instrumentation within the urethra and bladder, gentleness is of the utmost importance. Traumatism with subsequent bleeding

FIG 99

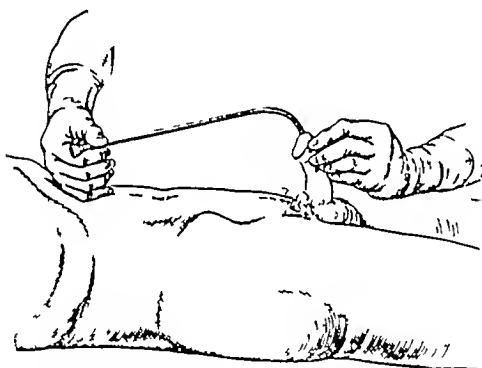


FIG 100

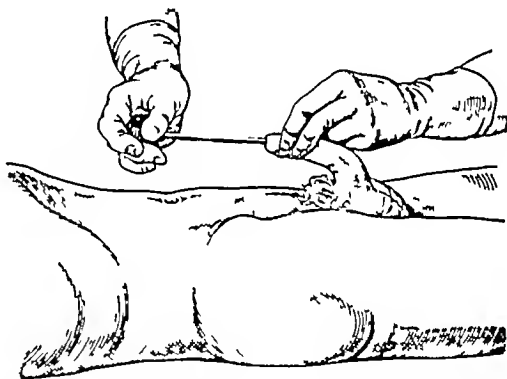


FIG 99—First step in passing sound or metal catheter. The tip of the instrument is seen to be inserted into external meatus with right hand while penis is held steady with the left hand. The operator should stand on left side of patient.

FIG 100—Second step of passage of sound, etc. (Compare with Fig 99) The sound is being passed along the lumen of the urethra while the penis is drawn up over the advancing instrument.

may cause painful and bloody urination for hours or days following, a chill may follow, a latent vesiculitis be stirred up and an epididymitis follow. The tearing of the urethral mucosa results in a scar, adding a superimposed traumatic stricture to a gonorrheal stricture.

For strictures of caliber less than No. 18 French, metal instruments should not be used except by those who are very proficient and with large experience. Danger of tearing through the urethral mucosa and making false passages with a narrow pointed metal instrument (Fig 77) are to be considered. For strictures of narrow caliber, bougies and filiforms, (Fig 75) which are more flexible than is a metal sound, should be used. When passing a sound and encountering resistance, some pressure may be applied in attempting to get by the stricture, but the pressure should not be forceful and if there is definite resistance, a smaller caliber instrument should be used.

It is well to examine the meatus to determine the size of sound that can

be inserted. Some meati are quite narrow and meatotomy¹ is necessary before sounds of large caliber can be introduced. The average urethra (Fig 46) should permit the passage of a No 24 F sound. In small men, this size may be too large. Most male urethrae permit No 27-29 F sounds to be passed and many much larger sizes.

Aside from the meatus, the other points where difficulties may arise in passing a sound are the membranous urethra and the bladder sphincter. The instrument must often be guided in the membranous urethra (Fig 102) with the hand on the perineum or pressure downward on the handle of the instrument, to permit passage through the triangular ligament. Spasm of the external sphincter (Fig 42) may prevent the introduction of the instrument into the bladder. This is usually readily overcome. Sometimes continuous pressure or allowing the spasm to subside for a few seconds, is sufficient. In rare cases the sphincter spasm is very difficult to overcome and the sphincters may relax only under general or caudal anesthesia. We have usually found that when either a sound or cystoscope presents difficulty in passage the wisest thing to do is to insert a finger in the rectum as a guide. This is the greatest aid in preventing trauma when passage of the instrument is found difficult for any reason.

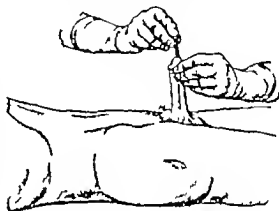


FIG. 101.—The sound encounters resistance in the bulbous portion of the urethra or at the anterior layer of the triangular ligament. (See Fig. 102.)

The important points are to keep the instrument in the median line and to allow it to enter by its own weight rather than by force. If the operator is right handed he should stand on the left side of the patient (Fig 94) with his back toward the patient's head. The penis has been cleansed and the lips of the meatus (Fig 95) are everted with the left hand. The prepuce should always be retracted back of the glans. A lubricant is applied on the sound and also to the meatus. An even better method of lubricating the urethra is to inject the urethra first with a lubricant, and then pass the instrument.

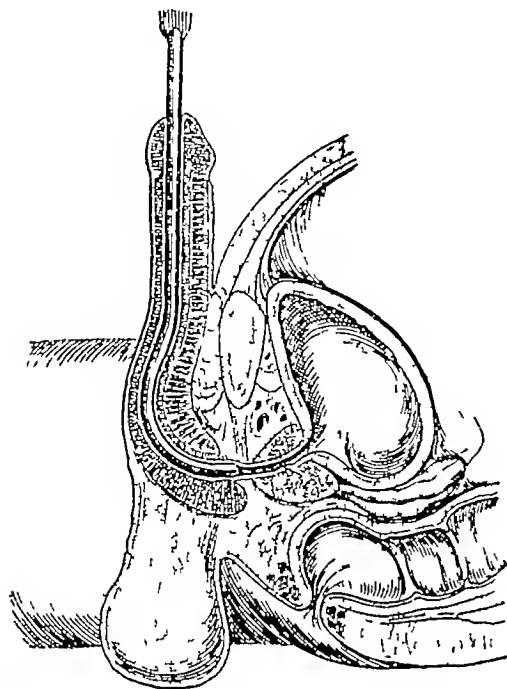
Technic. The following technic is to be recommended in passing a sound. The penis is pulled up and the tip of the sound inserted with the handle in the median line (Fig 100). The sound is now kept parallel with the body and pushed down gently still parallel with the body. On entering the membranous urethra the instrument takes a turn following the curve of the urethra and the sound follows this curve (Figs. 102 and 104) with gentle pressure on the handle. After the sound is at right angles to the body one can change hands and depress it somewhat to make a slight obtuse angle. At this angle the tip of the instrument is in the bladder.

Do not rotate the sound to determine whether it is in the bladder and do not depress the sound or push it inwards. Both are unnecessary and traumatize the bladder mucosa. The sound should be well lubricated during its passage.

Instrumentation is contraindicated in the presence of an acute inflammatory process in the urethra or in the presence of gonococci in the discharge. An im-

perative indication such as acute urinary retention outweighs these contraindications. In certain cases of chronic localized folliculitis with gonococci present, a sound may sometimes be passed into the first few inches of the anterior urethra

FIG 102



and the latter massaged over it

With greater experience in employing urethral instrumentation, the sound really becomes as it were a continuation of the fingers, the operator feeling perfectly at home and visualiz-

FIG 103

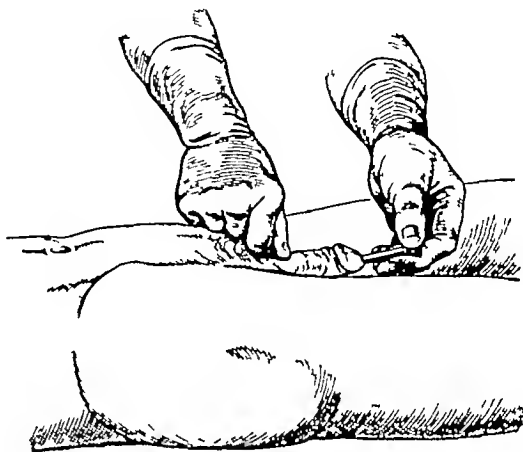


FIG 102—Sagittal section to show position of a sound with a Beniqué curve during second step of passage (Fig 101). Note resistance encountered by tip of sound at bulbomembranous junction (anterior layer of triangular ligament).

FIG 103—Third step of passage of sound, etc. While pressure is made in a downward direction over the root of the penis to relax its suspensory ligament (Fig 51) the tip of the sound is steadily but gently advanced while the handle is being depressed so as to follow the curve of the posterior urethra (Fig 104).

ing the location of the instrument in place and the steps in its advancement to the bladder

PASSAGE OF A CATHETER

Catheters² are of three types, rubber, woven silk and metal. The last named is employed in the same manner as a sound. The rubber catheter should be well lubricated and should not be too soft. The rubber catheter is inserted by a slight degree of pressure, with the penis pulled up, a technic such as is used in passing a sound is neither desirable or necessary. (The Tiemann catheter, which is a fairly stiff rubber catheter having a double coude curve, is rapidly replacing the Mercier woven silk catheter because it can be boiled, and can also be left in place as a retention catheter. The woven silk catheter cannot be used as a retention catheter.)

Woven silk catheters (often termed "hard rubber catheters") are particularly useful in prostatic hypertrophy. Some are shaped like a sound³ and others are straight like a bougie. Although the latter are valuable for the tortuous prostatic or for the strictured urethra, the ideal form is the Mercier catheter³ with

² See Chapter 4, Urologic Instruments

³ See Chapter 4, Urologic Instruments

either one or two bends or elbows near the tip (called *coudé* or *bi-coudé*) The particular value of the Mercier catheter is that it hugs the roof of the urethra,

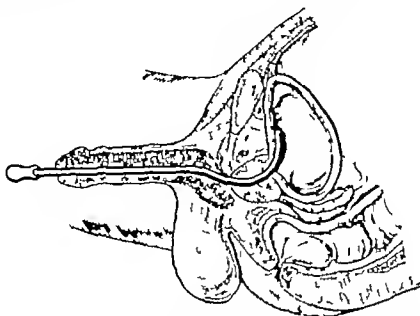


FIG. 104.—Sagittal section to show the curve of the posterior urethra which is most accurately followed by a Beniqué sound. The instrument has now entered the bladder.

upon which the prostate encroaches very little or not at all. It can be inserted with little difficulty in nearly all cases of acute retention due to prostatic hyper-

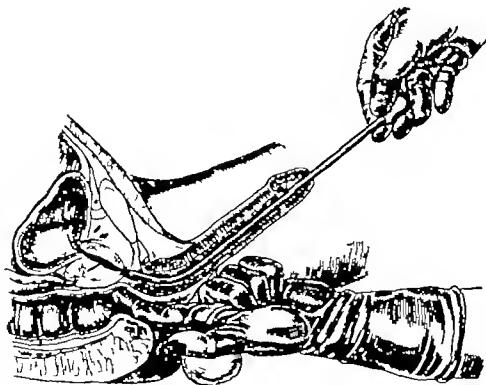


FIG. 105.—How to aid the passage of the sound, metal catheter or cystoscope either by pressure upwards over the perineum or by inserting the finger into the rectum (see illustration) so as to guide the instrument through the membranous and prostatic portions of the urethra.

trophy. Avoid the use of the Van Buren or Beniqué curve metal catheters in acute retention or at any other time in prostatitis.⁴ The urethra is tortuous,

As a last resort one can use a metal catheter with a *coudé* curve (Fig. 72.)

the metal catheter dips into the posterior wall of the urethra upon which the prostate is encroaching, making its passage practically impossible and causing considerable trauma. The soft rubber catheter bends too readily and is usually of no help unless threaded over a mandrin (Fig 110). In acute and subacute retention due to stricture, the patient will often urinate alongside a filiform. Following the passage of a filiform, bougie or sound, the patient is able to urinate as a result of relief of spasm of the sphincters and lessening of the edema.

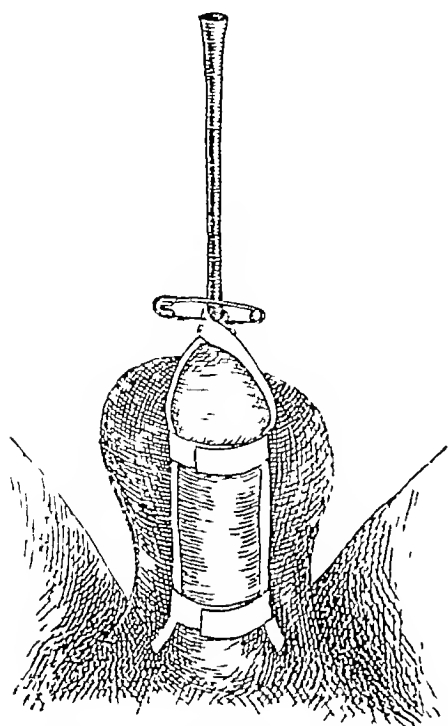


FIG 106—Technic for retention of inlying catheter in the male. Note how safety pin passes through loops of adhesive plaster and catheter just distal to external meatus.

Self-catheterization In old men with prostatic hypertrophy who are poor operative risks because of cardio-vascular or renal disturbances and emphysema, catheter life for the care of the chronic retention is sometimes indicated. Although this may often shorten the individual's life expectancy, on the other hand, some men go along comfortably for many years in this manner. The patient should be instructed how to pass the catheter.⁵

Retention or Indwelling or Inlying Catheter Following operation, some insert a suture through one of the lips of the meatus, or through the prepuce at the frenulum, and carry this suture through the catheter in order to hold it in place. This is not

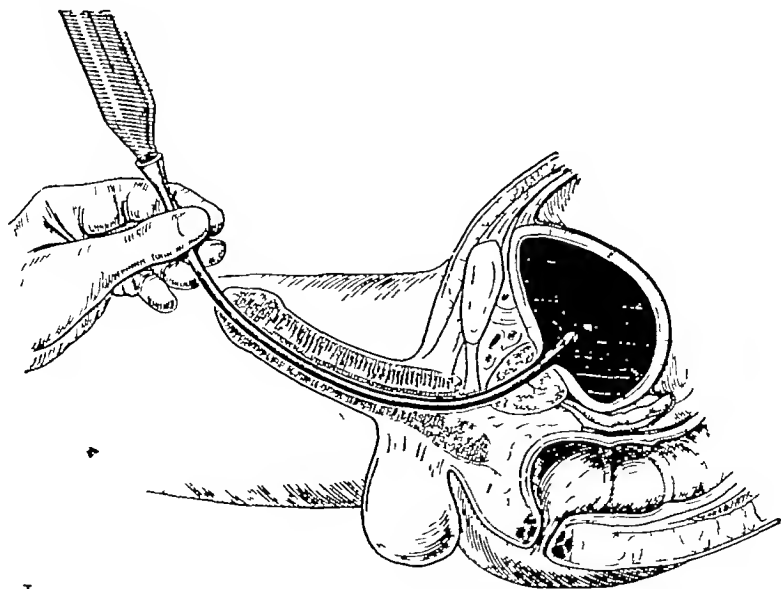


FIG 107—Irrigation of bladder with aid of catheter (Compare with Figs 108 and 109)

desirable for many reasons, and particularly because there are many better methods that can be used to keep a catheter in place. Various forms of bandage,

⁵ See special soft rubber catheters (Fig 68) which can be sterilized by boiling.

adhesive plaster and special rubber apparatus to attach to the penis and to keep the catheter from slipping can be recommended (Fig 106) The ordinary rubber (Nélaton) catheter can be used but one somewhat harder than a Nélaton with an olive tipped end or an open end is preferable (see Fig 67)

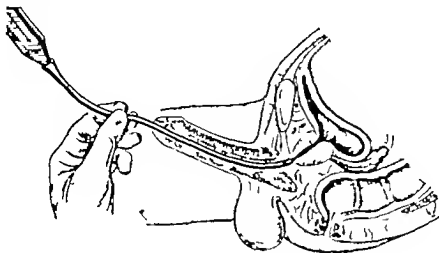


FIG. 108—Irrigation of posterior urethra with aid of catheter (Compare with Figs. 107 and 109)

The Use of Diagnostic Sounds. Olive-tipped sounds or bougies (Fig 74) should be part of the armamentarium of every office. With this instrument the caliber of a stricture can be determined and also its location in the urethra. It is employed for determining the presence of strictures in front of the membranous urethra. It is of little value for stricture of the membranous urethra for this

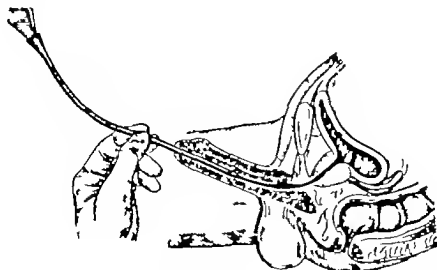


FIG. 109—Method of irrigation of anterior urethra with aid of catheter (Compare with Figs. 107 and 108)

part is narrow and the urethra begins its natural bend at this point. The olive-tip is the same in principle as that employed in esophageal stricture and stricture elsewhere. The tip passes the stricture with some ease but on the way out the stricture meets the widest part of the bulb first and noticeable resistance can be felt during withdrawal of the diagnostic bulb through the stricture.

INSTALLATION, IRRIGATION AND INJECTION

Urethral Instillation By instillation is meant the deposit of medication in small quantity into the bladder or urethra This can be done through a simple rubber catheter (Figs 107-108-109) or with the cystoscope in place or with a Guyon catheter (Fig 111) Instillation is most commonly employed for the posterior urethra, less often for the anterior urethra With the bull tip of a Guyon instillator one can determine having passed beyond the cut-off muscle or compressor urethrae muscle, into the posterior urethra This instillator is flexible and does not traumatize the inflamed urethra About 4 cc is enough for the posterior urethra and a similar amount for the anterior urethra The instrument is gradually withdrawn while the entire urethra is being injected The patient should hold the lips of the meatus firmly so as to retain the

FIG 110

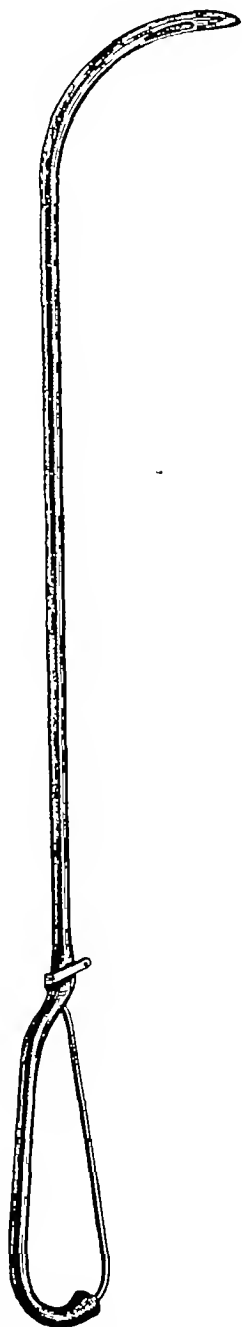


FIG 111

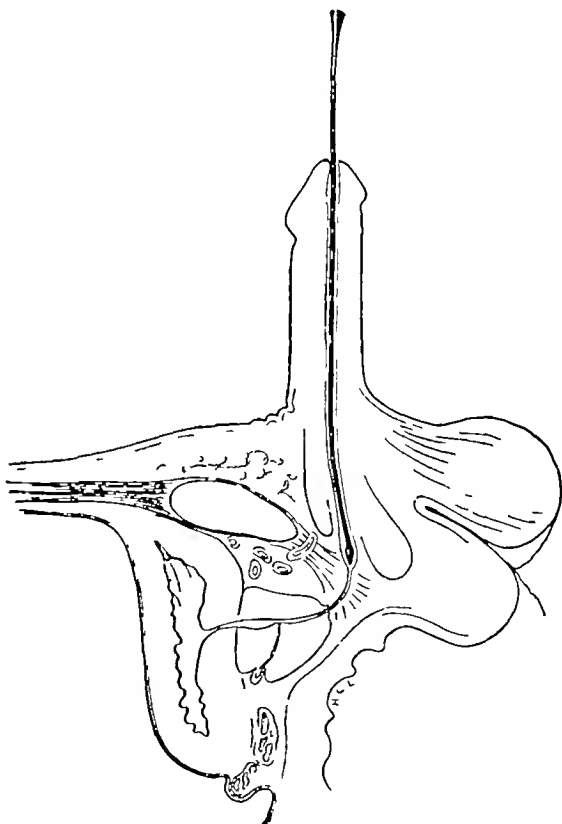


FIG 110—Soft rubber catheter threaded on mandrin (See Fig 70 for mandrin without catheter)
 FIG 111—Sagittal section of male urethra showing the Guyon instillator tip lying in bulbous portion of the urethra (See text)

solution for a few minutes Instillation of both the anterior and posterior urethra with gradually increasing strength of silver nitrate solution is a routine procedure with some urologists after passage of a sound

Urethral and Vesical Irrigation (Figs 108, 109, 110 and 94) Bladder irrigation can be made through a catheter with either a gravity irrigator attached (Fig 89) or bulb (Fig 87) syringe. In this manner a chronic cystitis can be irrigated and later, the bladder instilled. Irrigation is often necessary for a short time following prostatectomy. The tuberculous bladder does not tolerate irrigation and one may sometimes rupture an infiltrated bladder by excessive distention.

Irrigation of the posterior urethra (Figs 109 and 94) (posterior irrigation) can be either done with the eye of the catheter lodged in the posterior urethra or it can be irrigated directly from the meatus.^a In either case it can be carried out with a gravity irrigator (Fig 89) or a bulb syringe (Fig 87). For irrigating the posterior urethra in gonorrhea or in any other acute inflammation the catheter inserted in the posterior urethra and irrigation with gravity or syringe is safest.

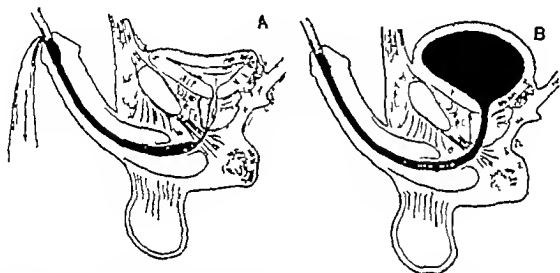


FIG. 112—Sagittal sections of male urethra to show in A the method of irrigating the anterior urethra and in B the method of irrigating entire urethra and bladder without the aid of a catheter.

The gravity method of Janet, of irrigating the posterior urethra by elevating the percolator six feet above the patient's body so that fluid the irrigating tip being held against (Fig 112) the meatus forces its way into the posterior urethra by overcoming the resistance of the external sphincter has been discarded to a large extent because of the resultant trauma and the frequent incidence of complications such as infections of the prostate vesicles and epididymis. The entire anterior urethra, the posterior urethra and bladder can be easily irrigated by inserting the tip of a bulb (Fig 88) into the meatus and merely employing hand pressure.

In inserting a catheter one can determine having reached the posterior urethra by the feeling of having overcome the resistance of the cut-off muscle. Another way is to insert the catheter into the bladder and then withdraw it (Figs. 107, 108 and 109) until the point is reached where there is no return flow.

The patient is instructed to open the mouth or breathe deeply so as to relax the external sphincter thus permitting the fluid to enter the posterior urethra.

from the catheter indicating that the tip has left the bladder. Fluid injected into the posterior urethra enters the bladder but does not escape through the catheter, remaining in the bladder. The same holds true for gravity irrigation of the bladder.

Irrigation of the Anterior Urethra (Figs 109 and 112) (Anterior Irrigation) The anterior urethra can also be irrigated with a catheter in place, after having completed the irrigation of the posterior urethra with either a syringe or the use of gravity. The fluid is immediately and constantly returned alongside (Fig 108) the catheter at the meatus. Anterior irrigation is usually given by the gravity method. With the irrigator about three feet above the patient's pubis, the tip (Fig 112) is pressed against the meatus and the fluid allowed to run in until the anterior urethra is distended. Then the irrigator tip is released from the meatus and the fluid allowed to run out. This is repeated a number of times. Between 75 and 100 cc of fluid should be used for each irrigation. The irrigator tip can be held (Fig 112) at the meatus but not very tightly and in this manner there may be a continuous irrigation of the urethra. The value of irrigation, aside from the mechanical cleansing and disinfection with the antiseptic medium, rests for the most part upon the distention of the urethra. The irrigation opens up all of the folds of the urethral mucosa, so that its main effect lies in the massage due to the distention and the resultant hyperemia.

Injection of the Anterior Meatus with a Hand Syringe The best type of hand syringe is the one with a bulb attachment (Fig 88) rather than a piston. It is easier to manipulate. Syringes should be made of glass, so that the patient or physician can see the quantity injected. The end should be blunt, of either glass or rubber, with the tip rounded and not sharp. A long tip which reaches one-half inch down into the urethra, is of no particular value and may do considerable damage.

In injecting, the prepuce should be retracted over the glans and all smegma removed. The glans is held between the thumb and index finger of the left hand and using the right hand, the fluid is injected. The lips of the meatus are everted with the left hand and the end of the syringe is pressed into the meatus. The penis should be pulled up somewhat. If the penis is pushed downwards, it will kink the urethra and interfere with the injection. If the prepuce is not retracted, the glans slips away and the injection fluid escapes.

The injected fluid should remain in the urethra for five minutes. The patient should always urinate before each injection, thereby washing out any pus on the surface which will interfere with medication and also preventing any of the pus and organisms being forced backwards.

Here as in gravity or metal syringe irrigation, the value of the procedure lies more in the distention produced by injecting the fluid, than the medication itself. For this reason, the urethra should be well distended at each injection and for this purpose a one or at least one-half ounce syringe should be used. The small size hand syringes most commonly used, are of little or no value.

There is no danger of spreading the infection by injecting the entire anterior urethra and distending it. It is unnecessary, as some patients and even some physicians believe, to hold the hand at the peno-scrotal junction to prevent the fluid from going back. Complete distention with a one or one-half ounce syringe is most

important The entire urethra (anterior and posterior) should be injected through and through when the posterior urethra is also involved If the fluid is forced in gently there is no danger of trauma and resulting aggravation of prostatitis or vesiculitis and no danger of producing epididymitis It is often advisable to inject warm water into the urethra before injecting the antiseptic, thus removing any pus or debris still present

CHAPTER 6

URETHROSCOPY, CYSTOSCOPY AND URETERAL CATHETERIZATION

URETHROSCOPY
CYSTOSCOPY

TECHNIC OF CYSTOSCOPY
URETERAL CATHETERIZATION

URETHROSCOPY

We have seen in Chapter 2 on anatomy of the urethra that the mucous membrane is arranged in a series of longitudinal folds which can be separated by the passage of an instrument or the escape of urine

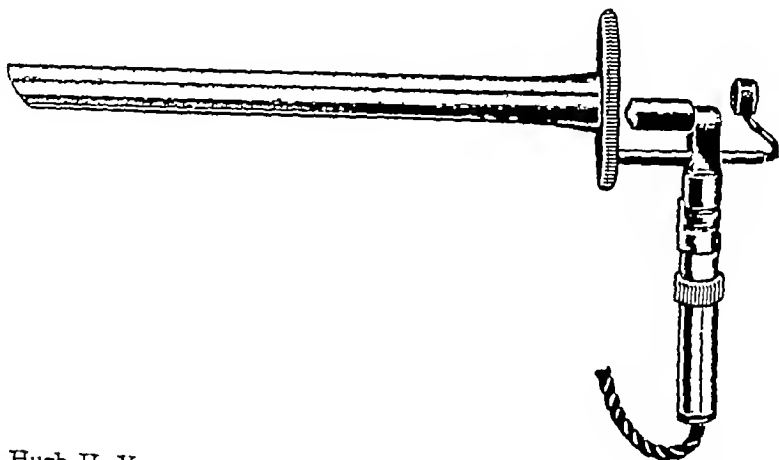


FIG 113—The Hugh H Young anterior urethroscope without obturator (Courtesy of V Mueller and Company)

Based on this anatomical knowledge two types of urethroscopes are employed, viz

(a) Those in which the separation of the walls is accomplished by the sheath alone, so that the only field is that at the distal end of the instrument. This might be termed the “dry” method to distinguish it from the second one.

(b) The irrigation method in which a constant flow of water acts to separate the folds of urethral mucosa and a view is obtained through a window on the side of the sheath. This view is then magnified by a series of lenses within the telescope of the instrument.

The first named or “dry” method is to be preferred for examination of the anterior urethra. There are a few urologists on the other hand who employ the irrigation urethroscope for the same purpose, i.e., inspection of the entire urethra. Our own experience, and we believe that this is the practice of the majority of urologists, is to employ the “dry” urethroscope (Fig 113) for examination and treatment of affections of the anterior urethra, i.e. pendulous and bulbous portions in the male and entire length of the urethra in the female. For the posterior urethra, i.e., inspection and treatment of the membranous and prostatic portions, catheterization of the ejaculatory ducts and examination of the vesical neck, the various types of irrigation cystoscopes are usually employed in most clinics in this country and abroad.

(a) Urethroscopy by the “Dry” Method. A simple straight metal tube of a size 24 to 26 F is to be preferred. An obturator closes the opening at the distal

end of the sheath (or tube) so that the urethral mucosa is not injured by the metallic edges of the opening at the end. Having sterilized the sheath and obturator by boiling they are well lubricated and inserted (Fig 114) while the patient lies supine on the table. The urethroscope is introduced its full length so that its distal opening lies in the bladder. The light and lens having been adjusted over the end of the tube nearest to the examiner, one proceeds to inspect the field at the distal end of the sheath. If urine mucus blood or pus obscure the view the lens and light are rotated aside and the fluid removed with cotton applicators. The lens and light are again rotated over the proximal end of the sheath. The structures which one sees are well shown in Plate 1. They are the following:

(a) The lower margin of the vesical sphincter

(b) The prostatic urethra with the verumontanum and the mucosa in front (premontane) and behind (retromontane portion), the latter extending to the vesical sphincter. In normal cases the veru (B of Plate 1) is rounded and covered with smooth pale red mucosa. At its middle one sees a shallow depression, the utricle, (Fig 47) and occasionally the openings of the ejaculatory ducts on the sides of the veru.

In the retromontane portion of the urethra, the blood vessels are seen to pursue a course which is parallel to the long axis of the urethra. As the urethroscope is withdrawn after observing the portion (premontane) immediately distal to the veru, the paler membranous urethra comes into view and then the bulb and pendulous portions.

The urethroscopic field in this instrument shows the lumen varying at different points from a pin point to a vertical slit with the folds of mucosa radiating from this central point (A and B of Plate 1).

The normal mucosa possesses a typical luster and is with but slight variations of a pale yellowish color and smooth. The ease with which the soft folds of the normal mucosa are separated as the instrument is advanced or withdrawn is in sharp contrast to the resistance or rigidity of these walls when an inflammatory infiltration is present as in cases of urethritis. The glands of Littre are quite numerous in the pendulous portion but their orifices are so small that they cannot be seen under normal conditions. This is not true however of the lacunae or crypts of Morgagni whose orifices are larger and can be seen as round openings or as semilunar folds or depressions scattered along the roof of the penile urethra. There are usually only about 10 to 30 of these lacunae. At times one sees some slits which run parallel to the long axis of the urethra. One of these usually is found just proximal to the external meatus.

As stated above the ordinary dry urethroscope (Fig 113) is of greater value for the diagnosis and treatment of lesions of the anterior urethra.

(b) Urethroscopy or Urethrocystoscopy by the Irrigation Method. There are two principal types of instruments in daily use (a) Those like the Buerger or the McCarthy cystourethroscope (Fig 115) (b) The new McCarthy



FIG. 114.—Method of introduction of "dry" urethroscopes of Young Swinburne and similar types.

Foroblique Panendoscope, which can be used for the posterior urethra and bladder as well as for the ureters

Technic of cystourethroscopy, i.e. for posterior urethra and vesical neck

The external genitalia should be thoroughly washed with green soap and water followed by the application of a 1-5000 Bimiodide of Mercury solution. The obturator (Fig 115) having been inserted into the sheath, the instrument is introduced in the same manner as a sound (See Chapter 5). As soon as the bladder is reached the obturator is withdrawn and the catheterizing telescope (Fig 115) introduced. The urethrocystoscope is then connected by means of its inflow faucet with a rubber tube leading to an irrigator (filled with sterile water) and another rubber tube attached to the outflow faucet (Fig 115). Water is then allowed to circulate through the instrument and separate the walls of the urethra. If there is any bleeding or the field is not clear, it is advisable to discontinue the flow of water for a time, thus allowing the clots or pus to gravitate to the floor of the bladder and inspect the field again.

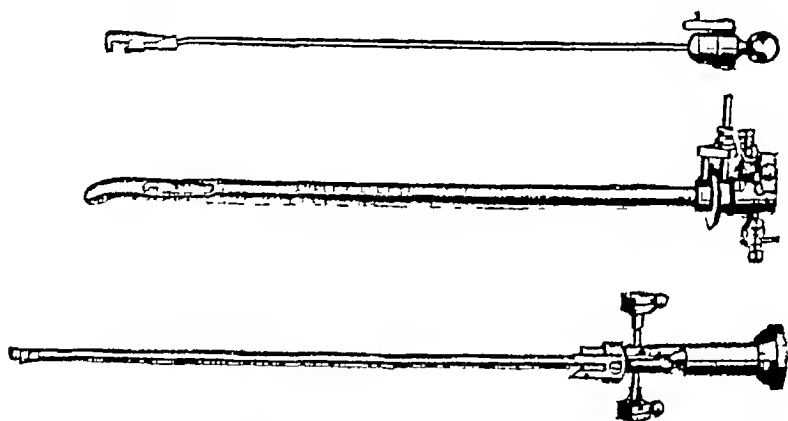


FIG 115—McCarthy Posterior (irrigation type) Urethroscopy. The mandrin, or obturator, sheath and telescope are shown in order named, from above downwards.

One begins as was described under "dry" urethroscopy by inspection of the trigone and sphincter region. As the instrument is withdrawn, the continuous flow (or intermittent as the individual case requires) of water separates the walls of the urethra so completely, that every detail of the normal conditions or pathological changes are seen in a far more satisfactory manner than by the "dry" method.

The verumontanum with the utricle in its center (B of Plate I), occasionally the openings of the ejaculatory ducts and the portions of the urethra in front and behind the veru, are easily demonstrable by this method. For the diagnosis and treatment of pathological conditions such as those incident to chronic urethritis, prostatic adenoma with its encroachment upon the retromontane portion of the urethra, papillomata, median bar etc. the ordinary posterior urethroscopes of Buerger or McCarthy (older model or the newer foroblique) have almost completely supplanted the "dry" method.

Treatment of lesions of the posterior urethra and catheterization of the ejaculatory ducts can also be carried out far more easily with some form of irrigation urethroscope.

The Buerger or McCarthy cystourethroscopes are both about 24 F. An instrument of smaller caliber is now being made both in this country and abroad and is to be preferred for inspection and treatment of the posterior urethra alone, in men who have a narrow external meatus. A convertible cystourethroscope is being

PLATE I

- A Prostatic urethra as seen through urethroscope Note protrusion into lumen of the lateral prostatic lobes (Henry Demonchy)
- B Verumontanum with utricle
- C Bulbous portion of urethra
- D Bullous edema of prostatic urethra
- E Polyp protruding from orifice of utricle
- F Soft infiltration of membranous portion of urethra

A



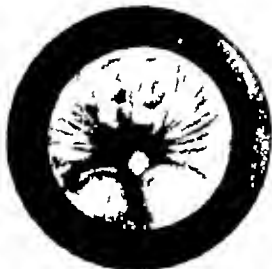
B



C



D



E



F



manufactured which can also be employed for catheterization of both ureters. The tendency at present is to reduce the number of instruments and combine in one the demands for inspection and treatment of the urethra and bladder with the ability not only to catheterize but also to dilate the ureters (as in cases of calculi or strictures)

CYSTOSCOPY

Use of Term Cystoscope The original Nitze cystoscope consisted of a closed tube in the interior of which were placed a system of lenses to magnify the field so that it was larger than could be seen through an ordinary tube

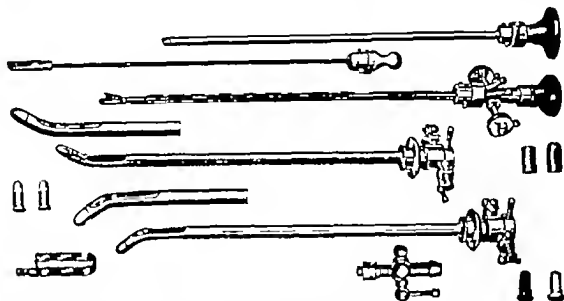


FIG 116—Brown-Bueger examining and double catheterizing cystoscope (sizes 21 and 24 F). From above downward, note examining telescope, obturator, catheterizing telescope, concave and convex sheaths. (Courtesy American Cystoscope Makers Inc.)

without such lenses. Since that epoch making instrument, the principle has been applied to a number of modifications but the original term cystoscope has been retained even though it be combined with facilities for catheterizing or passing relatively large bougies into the ureters or of introducing through the sheath various instruments for the treatment of bladder lesions.

Essential Components of Present Day Cystoscopes Although there are differences in details of construction of cystoscopes both in this country and abroad, the four principal parts are fundamentally alike. These at least in cystoscopes (Fig 116) of American manufacture are:

1. A SHEATH with an opening or window near the beak, either on the concave or convex side. The tip of this sheath has a space for a lamp of low voltage which receives its current by means of fine wires placed in the wall of the sheath.

2. AN OBTURATOR. By means of a special mechanism this not only occludes the working aperture or window (Fig 116) but when fully introduced is flush with the exterior of the sheath so that no projecting edge may injure the mucous membrane of the urethra during the introduction of the instrument.

3. AN OBSERVATION TELESCOPE which has a right angled prism near its tip (see Fig 116) with two sides silvered. This prism enables a relatively large field to be deflected at right angles and carried through a system of lenses to the eye of the observer.

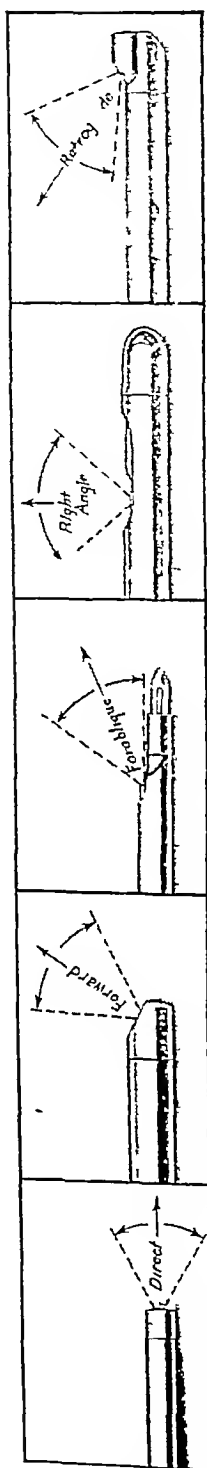
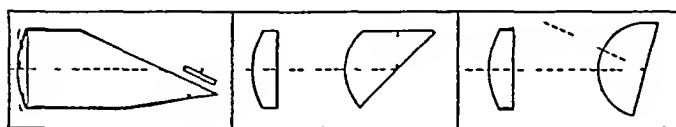


FIG 118—Optical systems most frequently employed in various types of cystoscopes (Courtesy of American Cystoscope Makers, Inc.)



Double-Acting
(Forward)

Hemispherical
(Right Angle)

Hemispherical
(Retrograde)

FIG 117—Methods used to obtain various angles of vision in cystoscopes (Courtesy of American Cystoscope Makers Inc.)

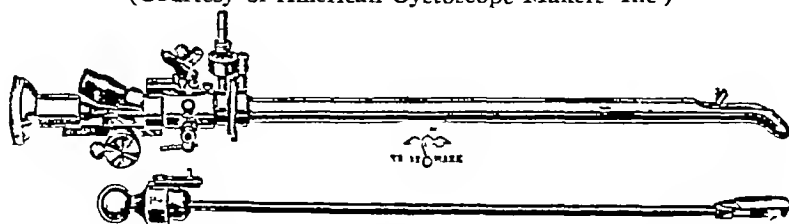


FIG 119—McCarthy Operating Cystoscope for intravesical operations and passage of large (up to 12 F) ureteral bougies

4 A CATHETERIZING TELESCOPE which is constructed on the same principle as the observation telescope but in addition carries one or two channels or grooves for ureteral catheters and a deflector near its tip (Fig 115), so that the end of the catheter is introduced along these channels and can be accurately directed towards an object, e g, ureteral orifice by raising or lowering this deflector or elevator. Two discs, one on each side of the catheterizing telescope, enable the operator to manipulate the mechanism regulating the movements of this deflector.

Optical Systems In the original Nitze instrument, the image was deviated at a right angle (see Fig 117) so as to pass parallel to the long axis of the cystoscope to the eye of the observer. This image, however, was inverted and it was necessary to insert a number of lenses in the observation telescope to correct this.

The different optical systems now employed are (a) direct vision without magnification of the image, (b) forward vision (c) foroblique principle, (d) the right angle system and (e) the retrograde lens. These are all shown in Fig 118.

Cystoscopes most frequently employed for adults, include the following:

For Urethroscopy and Bilateral Ureteral Catheterization

- 1 Brown-Buerger cystoscopes—size 21 F (preferable) and 24 F with both concave and convex sheaths (Fig 116). Can be furnished with right angle, forward vision or retrospective examining telescopes.

- 2 McCarthy foroblique pan-endoscope with foroblique, right angle and retrospective examining telescopes.

- 3 Braasch direct vision cystoscope

- 4 Ravich convertible cystoscope, size 21 F

- 5 Young improved cystoscope

For urethrocystoscopy and unilateral ureteral catheterization.
Brown Buerger single catheterizing cystoscope sizes 16 F and 18 F

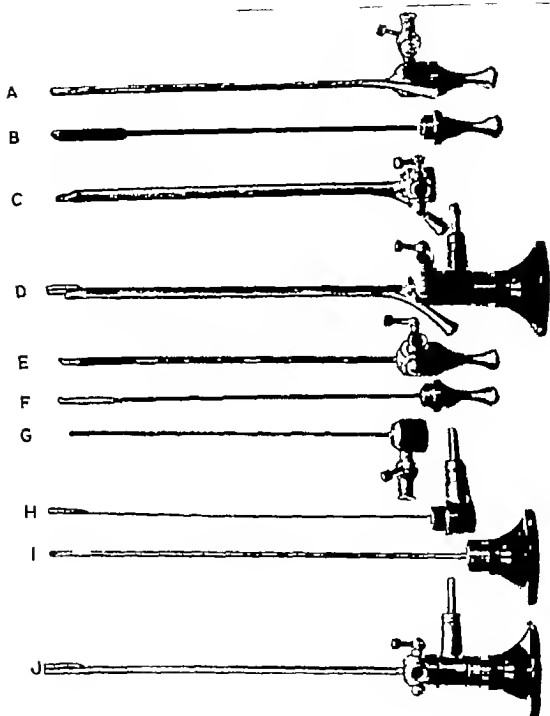


FIG. 120—Campbell's miniature cystoscopic outfit introducing a new principle in illumination arrangement. With this set can be performed practically every instrumental procedure demanded in Pediatric Urology. A 1 F double catheterizing sheath with obturator B Obturator and C Sheath in A D Assembled 12 F instrument. Note the position of the light A for oblique telescope is shown. E 8.5 F observation sheath with obturator F Obturator and G sheath in E. H Removable light carrier I Right angle vision telescope J Assembled 8.5 F observation cystoscope. With this instrument observation cystourethroscopy can readily be performed in a new born male (Courtesy Campbell's Pediatric Urology and The Macmillan Company)

For Urethrocystoscopic Examination and Treatment

- 1 McCarthy operating cystourethroscope (Fig 119)
- 2 McCarthy for oblique pan-endoscope

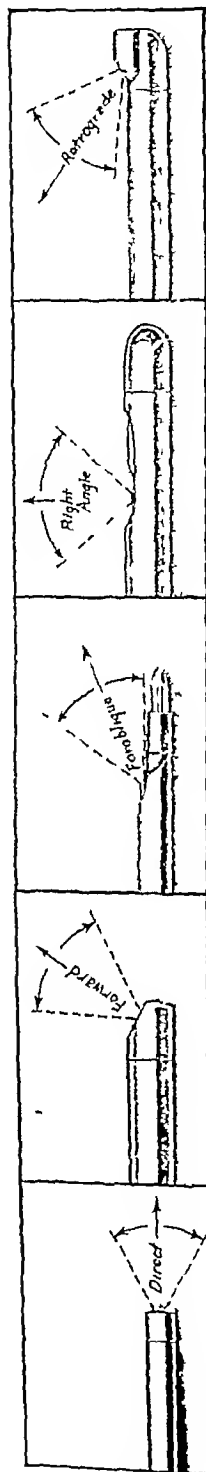
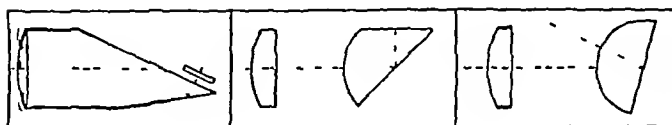


FIG 118—Optical systems most frequently employed in various types of cystoscopes (Courtesy of American Cystoscope Makers, Inc)



Double Acting
(Forward)

Hemispherical
(Right Angle)

Hemispherical
(Retrograde)

FIG 117—Methods used to obtain various angles of vision in cystoscopes (Courtesy of American Cystoscope Makers, Inc)

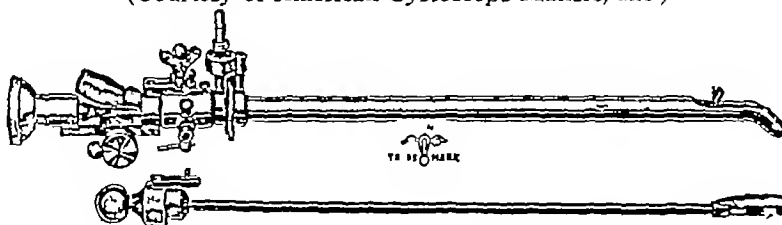


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4 A CATHETERIZING TELESCOPE which is constructed on the same principle as the observation telescope but in addition carries one or two channels or grooves for ureteral catheters and a deflector near its tip (Fig 115), so that the end of the catheter is introduced along these channels and can be accurately directed towards an object, e g, ureteral orifice by raising or lowering this deflector or elevator Two discs, one on each side of the catheterizing telescope, enable the operator to manipulate the mechanism regulating the movements of this deflector

Optical Systems In the original Nitze instrument, the image was deviated at a right angle (see Fig 117) so as to pass parallel to the long axis of the cystoscope to the eye of the observer This image, however, was inverted and it was necessary to insert a number of lenses in the observation telescope to correct this

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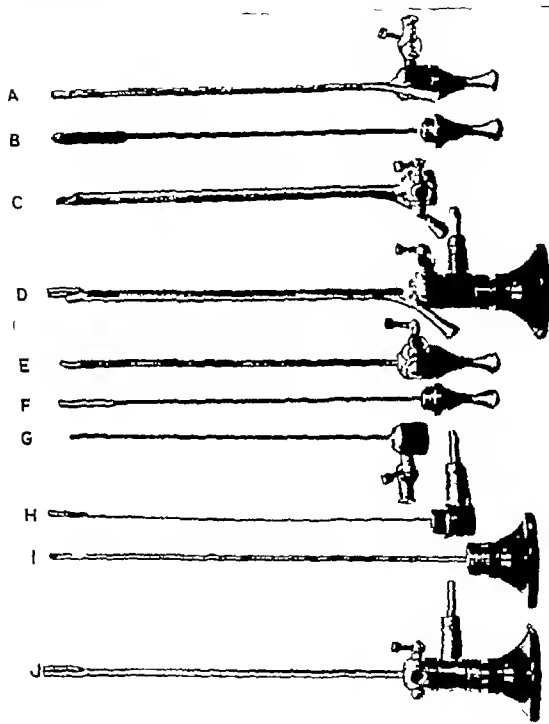


FIG. 120.—Campbell's miniature cystoscopic outfit introducing a new principle in illumination arrangement. With this set can be performed practically every instrumental procedure demanded in Pediatric Urology. A, 12 F double catheterizing sheath with obturator B Obturator and C Sheath in A. D Assembled 12 F instrument. Note the position of the light A for oblique telescope is shown E 8.5 F observation sheath with obturator F Obturator and G sheath in E. H Removable light carrier I Right-angle vision telescope. J Assembled 8.5 F observation cystoscope. With this instrument observation cystourethroscopy can readily be performed in a new born male (Courtesy Campbell's Pediatric Urology and The Macmillan Company)

For Urethrocystoscopic Examination and Treatment.

- 1 McCarthy operating cystourethroscope (Fig 119)
- 2 McCarthy foroblique pan-endoscope

For Cystoscopy Alone

The 18 F Brown-Buerger irrigation cystoscope with removable telescope

Cystoscopes Most Frequently Employed for Children

- 1 Butterfield double catheterizing cysto-urethroscope
- 2 Campbell miniature cystoscopic outfit (Fig 120)

TECHNIC OF CYSTOSCOPY (OR OF URETHROCYSTOSCOPY)

The patient is placed upon a special table with the pelvis slightly elevated and thighs and leg supported upon some form of holder (preferably on the Bierhoff principle) and separated sufficiently to enable the operator to work without being cramped for space. The external genitalia are washed with gauze or cotton soaked in well diluted green soap solution which is removed by pouring water over the parts, until all of the soap is washed away. A solution of 1-5000 Bimiodide of Mercury is next freely applied, especial care being taken to retract the prepuce, well. The cystoscope (which we prefer to sterilize by washing thoroughly after use, with soap and running water and immersing in a 1-5000 Bimiodide of Mercury

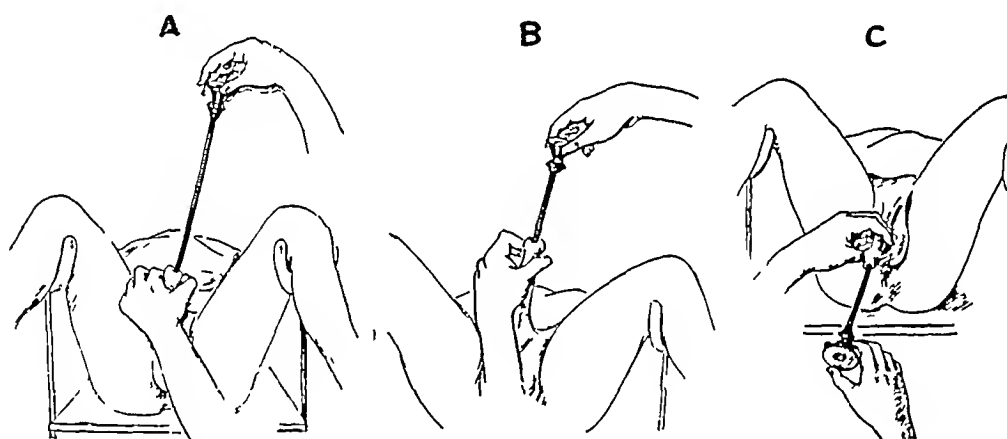


FIG 121—How to introduce cystoscope

- A Penis pulled over beak of cystoscope
 B Cystoscope obstructed in bulbous portion of urethra but penis continually pulled over instrument until obstruction passed
 C Depressing instrument as it passes through membranous and prostatic portions of the urethra (After Eugene Joseph)

solution for 10 minutes before using), is always examined before being introduced to see (a) if its lamp is in good order, (b) whether the mechanism which raises or lowers the deflector (Fig 116) at the end of the catheterizing telescope is functioning properly. We then ascertain whether the ureteral catheters are pervious and that the tips (especially is this true of the flute (Fig 81) variety), are not so friable as to be liable to break off while in the bladder or ureter. The urethra and bladder neck are now anesthetized, as described in Chapter 9.

In babies and young children, one is usually compelled to administer a general anesthetic.

Two further observations should be made before the cystoscope is introduced viz, (a) the size of the external meatus in both sexes. Stricture of the urethra in women, and this is especially true of the external meatus, is not as uncommon as has been generally thought. We must never force a larger size cystoscope through the external meatus than it will easily admit. If it is very narrow

a preliminary dilatation with special short sounds (Fig 89) is very helpful in enabling one to use a larger cystoscope (b) Always pass a No 24 bulbous bougie along the entire length of the male urethra in order to be saved the embarrassment of attempting to insert a cystoscope through a narrow and at times almost impermeable urethral stricture

We are now ready to introduce the well lubricated sheath (Fig 116) into which the obturator has been inserted The technic of introduction of a cystoscope is shown in Fig 121 The obturator is withdrawn as soon as the bladder neck has been passed and the urine allowed to escape into a conical glass The stop-cock on the side of the sheath of the cystoscope is now connected by a rubber tube with an irrigator filled with lukewarm sterile water The temperature of this must not be too high (not over 98 degrees) because if too warm it causes the tips of the ureteral catheters to be so soft that it is more difficult to introduce and to advance them through the ureteral orifices and

FIG. 123

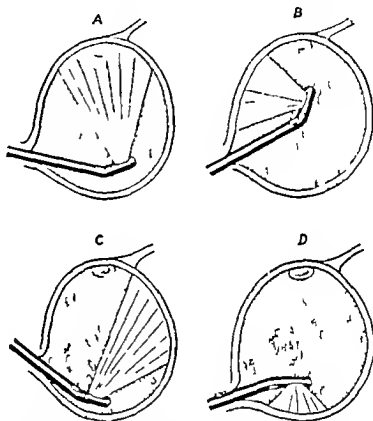


FIG 122



FIG 122—Ertzbischoff cut-off for use in cystoscopy The flow of the distending medium can be easily regulated.

FIG 123—Diagrams to show order of examination of bladder

- A. Superior wall and upper border of internal meatus
- B. Anterior wall (can be seen only with retrograde vision cystoscope)
- C. Inspection of posterior and lateral wall
- D. Examination of trigone and lower border of vesical neck.

lowermost portion of the ureter We prefer an irrigator to the use of syringes in filling the bladder determining the amount needed by the degree of intravesical tension as exerted by the fluid pressure against the finger held over the outer open end of the cystoscope sheath One needs an average amount of 150 cc of distending medium (always water) for adult males and 180 cc. for adult females and corresponding smaller amounts in children If the bladder is very small or contracted or very irritable and will not tolerate more than 90 cc it is almost impossible to make an examination of any value It is far better in such cases to do the cystoscopy under sacral or Caudal anesthesia (see Chapter 9) One

Oil or vaseline must never be employed. Only glycerin alone or mixed with gelatin as prepared by a number of supply houses should be used.

An apparatus such as is shown in Fig. 122 simplifies the flow of the distending medium.

They vary (See Figs 125 and 126) greatly in shape and size even under normal conditions and may be

- (a) Oval
- (b) Circular—and often very minute
- (c) Crescentic—one lip overhanging the other
- (d) Slit-like

The orifices or ureteral meati do not always lie at the apex of the corresponding papilla. They may be located lateral to and behind it (Fig 125) or so close to the sphincter that they can be easily overlooked. This latter condition is often seen in men with a much shortened trigone. In women with cystocele, the entire trigone may be hidden in the pouch so that the orifices are hard to find. The same is true of cases of prostatic adenoma in which they lie in the "valley" or pouch (Fig 130) behind the intravesical prostatic protrusion. At times the orifices even

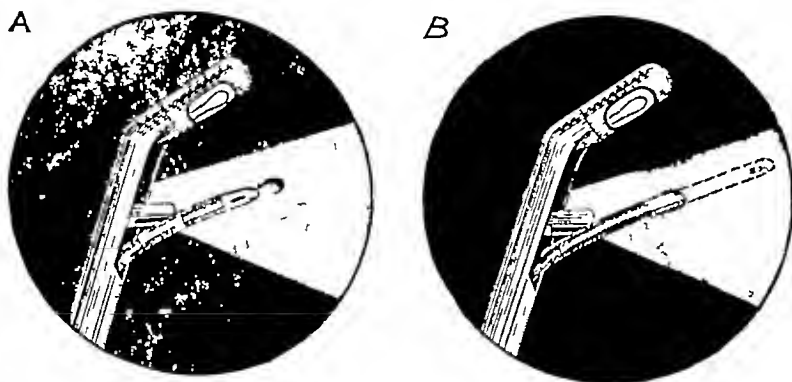


FIG 127—Diagrammatic representation of first two steps of ureteral catheterization (Compare with close up view as shown in Fig 128.)

A Beak of cystoscope approached as closely as possible to ureteral orifice so that catheter tip can be well controlled by elevator

B Beak held firmly, close to ureteral orifice with elevator raised, so that catheter can be readily inserted into the ureter

under normal conditions may be so minute as to necessitate the use of indigo-carmin to locate them by the subsequent blue efflux. One must always be on the lookout (Fig 132) for double ureteral orifices on one or both sides, for the absence of an orifice on one side and also its location at some abnormal point in the bladder or urethra.

URETERAL CATHETERIZATION

Having inspected the bladder (usually also the posterior urethra) and ureteral orifices, we proceed to insert catheters or, as the case demands, bougies, through these orifices, as high⁵ as the renal pelvis. The examining telescope (Fig 116) is quickly withdrawn and the catheterizing telescope with one or two catheters (according to the number of channels) is inserted into the sheath. Our procedure from this point on is to first push the catheters along their channels until the tips are visible in the field (Fig 127). One of the two catheters is withdrawn slightly

⁵ The average distance from the ureteral orifice to the renal pelvis is 23-25 cm. If an obstruction is encountered, its level can be measured by slowly withdrawing the catheter and noting the number of markings (each 1 cm apart) at which the arrest occurred.

PLATE II

A Normal bladder mucosa (Joseph)

B Left angle of trigone with ureteral orifice Note vascularity of trigone as compared to remainder of bladder wall (Joseph)

C Marked hyperemia as seen in early stage of cystitis (Joseph)

D Thickened mucosa as seen in chronic cystitis (Joseph)

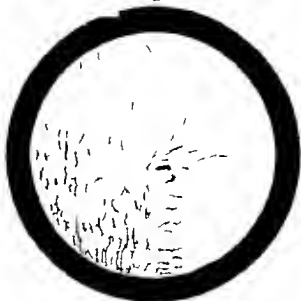
E Edema bullosum as seen at a distance in acute and also in chronic cystitis (Joseph)

F Cystitis cystica Mucosa studded with minute flat elevations (Joseph)

A



B



C



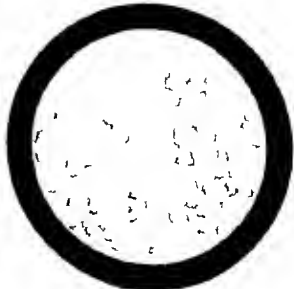
D



E



F



and the beak of the cystoscope is brought as close as possible (Fig 127) to the ureteral orifice.

The catheter is then pushed beyond the opening in the cystoscope while the deflector (Fig 116) is raised or lowered until the catheter is close to and then enters the orifice (Fig 128) Keeping the cystoscope firmly in close relation to the ureteral orifice is one of the essential steps. The catheter is pushed farther and

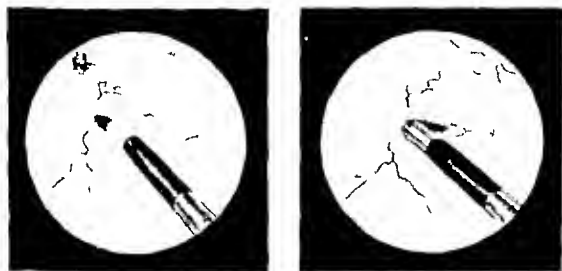


FIG. 128—Steps of ureteral catheterization. Close up view of Fig 127 to show catheter just before introduction into ureteral orifice (on left) and its insertion into orifice (on right)

farther into the ureter until the renal pelvis is reached which is indicated as a rule by the intermittent appearance of urine usually 6 or 8 drops then an interval and the cycle repeats. The secret of making ureteral catheterization easy or difficult is to approach the orifice so closely (Fig 127) that the catheter aided by the deflector at the distal end of the catheterizing telescope is under as complete

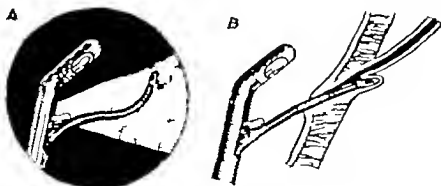


FIG. 129—Diagrams to illustrate faulty method (A) of ureteral catheterization and an obstacle often encountered as shown in B

A. Beak of cystoscope too far away from orifice so catheter tip cannot be controlled and bends easily

B. Ureteral catheter tip caught in fold of mucous membrane of intramural portion of ureter

control as though one were inserting a catheter into the external urethral meatus. The farther away the beak of the cystoscope is from the ureteral orifice the greater the possible range of excursion of the catheter and the less certain is our control of its tip.

In the McCarthy foroblique panendoscope one greatly misses at first the assistance given by the deflector of the ordinary catheterizing telescope (Fig 116)

but after a little practice, the ability to enter the ureters without such aid is rapidly acquired

There are a Number of Difficulties⁶ Encountered in Ureteral Catheterization (Fig 129) The more important of these are

1 TOO FLEXIBLE A CATHETER TIP, due either to the water used for distending the bladder being too hot or to faulty manufacture In order to avoid the former we place the ureteral catheters in ice water as soon as they have been boiled (see page for method of catheter sterilization)

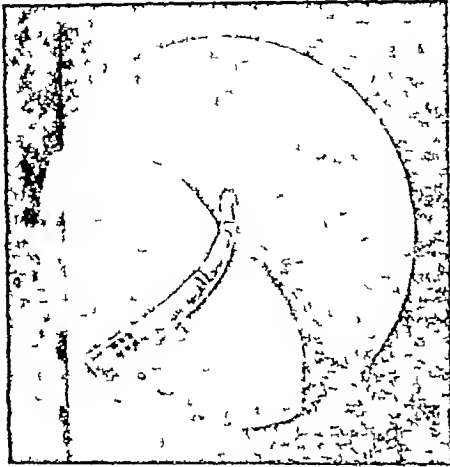


FIG 130—Ureteral catheterization in patient with large middle lobe prostatic hypertrophy Note how orifice lies in pouch behind prostate (After Papin)

2 THE ATTEMPT TO INTRODUCE A LARGER SIZE CATHETER THAN THE ORIFICE WILL ADMIT or the use of a flute or cylindric tip (Fig 81) when the only one which can be passed is one with an olivary tip (Fig 81) One should never fail to have an assortment of all the sizes (4 to 6 F) and of tips, (flute, cylindric and olivary) ready for immediate use

3 A FOLD OF MUCOSA (ureteral) (Fig 129) or a muscular spasm may arrest the tip of the catheter The same is true of a stricture, kink, calculus, etc

4 THE ABNORMAL LOCATION AND SIZE have already been called attention to The orifice may be at the base of an ulcer or in

a diverticulum of the bladder or at the bottom of a cystocele pouch or hidden behind an enlarged prostate (Fig 130)

Both catheters having been introduced as high as the respective renal pelves, we proceed to first take off the rubber caps through which the catheters have been inserted into the channels of the catheterizing telescope and push the catheters toward the bladder while this telescope is pulled out of the sheath The latter is

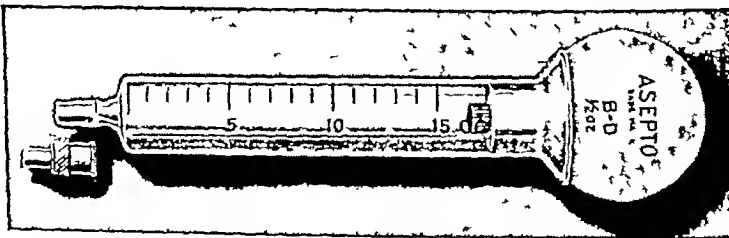


FIG 131—Bransford Lewis bulb syringe for pyelography or for irrigation of the renal pelvis The lumen of the tip tapers so that the ureteral catheter is firmly grasped

kept so that its beak is directed upwards and slowly withdrawn as the catheters are pushed still further into the urethra and left in situ With the rapidly increasing use of combined cystoscopic and radiographic tables this will seldom be necessary in the future We now proceed to collect the separate specimens in test tubes or

⁶ It will have been noted that but little reference to pathological conditions was made in this chapter These will be taken up under the individual diseases so as to avoid unnecessary repetition and also to make the task easier, of learning normal conditions

small bottles or better still use syringes (Fig 131) to empty the renal pelvis more rapidly and at the same time enable one to estimate any retention. If one watches the urine escape without any such aspiration, there will be five or six drops in rapid succession, then an interval of 10-15 seconds and the cycle is repeated. In cases of hydronephrosis or after a ureteral "block" (obstruction) is relieved there is an almost continuous flow. In very nervous individuals this is also a common observation. On the other hand it is not unusual to see a temporary anuria following the introduction of ureteral catheters which subsides after injecting some warm water into the renal pelvis or by giving the patient some hot fluids. We would advise, however, against the ingestion of too much liquid before a ureteral catheterization as severe reflex nausea and vomiting are often seen in such patients while the pelvis is being filled during pyelography. After collecting urine⁷ from each kidney



FIG 132—Most common relations of the two ureteral orifices in cases of complete reduplication of the ureters and renal pelvis (double kidney)

A. Parallel, i.e. at same level

B. In tandem relation the one below and more mesial is as a rule the one corresponding to the lower half of the double kidney (Courtesy of Dr. Baetjer)

for ten minutes it is our custom to inject intravenously the dye which is to be employed for estimating the renal function (See Chap 8). The catheters are left in situ until all plain radiographic and urographic work (See Chap 7) has been completed.

In order to identify the catheters if the cystoscope has been removed, the outer end of the left one is cut obliquely. The completion of the examination, i.e. ascending or retrograde urography etc. are taken up in the chapter on radiography.

The separate urines are examined chemically, microscopically and bacteriologically (see Chap 8).

CHAPTER 7

RADIOGRAPHY OF THE UROGENITAL TRACT

DIAGNOSTIC METHODS

SIMPLE RADIOGRAPHY

RADIOGRAPHY WITH THE AID OF OPAQUE URE-

TERAL CATHETERS

ASCENDING OR RETROGRADE UROGRAPHY

EXCRETORY OR DESCENDING UROGRAPHY

CYSTOGRAPHY

URETHROGRAPHY

SEMINAL VESICULOGRAPHY AND RADIOGRAPHY OF THE EPIDIDYMIS

DIAGNOSTIC METHODS

The diagnostic methods most frequently employed in conjunction with Radiography are

- 1 Plain radiography, i.e. without artificial aids
- 2 Radiography with the aid of opaque ureteral catheters
- 3 Ascending or retrograde urography
- 4 Descending or excretory urography
- 5 Cystography
- 6 Urethriography
- 7 Seminal vesiculography

The less frequently employed methods are

- 8 Pneumoradiography (See Chapter on Renal and pararenal neoplasms)
- 9 Pneumopyelography
- 10 Pyeloscopy
- 11 Combined cholecystography and urography (See Chapter on Nephrolithiasis)
- 12 Aortography

1 SIMPLE RADIOGRAPHY¹ I.E. WITHOUT ARTIFICIAL AIDS

By this method is understood the taking of a picture of the entire urinary tract, before any of the other methods mentioned above are used. The chief value of this plain film or "flat plate" method is to yield information as to the presence of any abnormal shadows, within or adjacent to the urinary tract.

The preparation of the patient for all of the above named methods is practically the same. The greatest obstacle to good pictures is the presence of gas in the small and large intestine. We restrict our preparation to abstinence of cathartics, enemas and residue-giving food for twelve hours before the examination. If the latter is to be made in the morning, the patient is asked to take only coffee or tea without milk, for breakfast.

Shadows due to bismuth or barium taken by mouth or given as enemas, prior to the examination, must always be kept in mind, in the interpretation of shadows on the plain film. We have known them to persist for two to three weeks after cessation of the use of these shadow-giving preparations.

Barium examination of the alimentary tract should always follow and not precede that of the urinary tract.

Areas to be Exposed It is preferable to employ a single (14 x 17 in.)

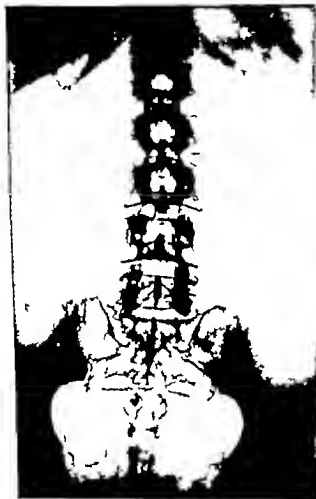
¹ The terms "plain film" or "flat plate" are employed frequently instead of "plain radiograph."

film for the entire urinary tract. A smaller size (11 x 14 in) suffices for the pelvis (cystography urethrography or vesiculography) alone

The film of the entire urinary tract (Fig 133) must include

- (a) The entire twelfth and greater part of the eleventh rib
- (b) The last dorsal and all of the lumbar vertebrae
- (c) All of the bony pelvis down to the upper border of the pubic symphysis

FIG. 133



It should be possible to see the details of the bony structures and the outlines of the psoas muscle

At times, the shadows of one (Fig 134) or both kidneys can be seen but this is of less value since the introduction of urography. The use of the Bucky Potter diaphragm

FIG. 134



FIG. 133—Print showing qualifications of plain radiograph of entire urinary tract. One should be able to see the last two ribs, bodies and transverse processes of all of the lumbar vertebrae, outlines of psoas muscle and a detailed structure of the sacrum. The shadows of the lower two-thirds of both kidneys were visible in the original film.

FIG. 134—Print of radiographic film showing entire shadow of right kidney. Note its relation to spine (being directed obliquely outwards) and to last ribs. (See Chapter 2 on Anatomy)

and of combined radiographic-cystoscopic tables of the Braasch Bumpus, Young or Squier types has greatly simplified the task of the urologist.

Variations in Position of Patient.

FOR THE KIDNEY AND URETER

- (a) Horizontal (Patient lying on the back, for anteroposterior views.
- (b) Lateral (patient lies on right or left side)
- (c) Horizontal (Fig 135) followed by upright (sitting up) or even standing positions

The first named is the routine method and may be supplemented by one or

both of the others. The last named method is especially useful in the determination of the range of mobility of the kidney before or after nephropexy.

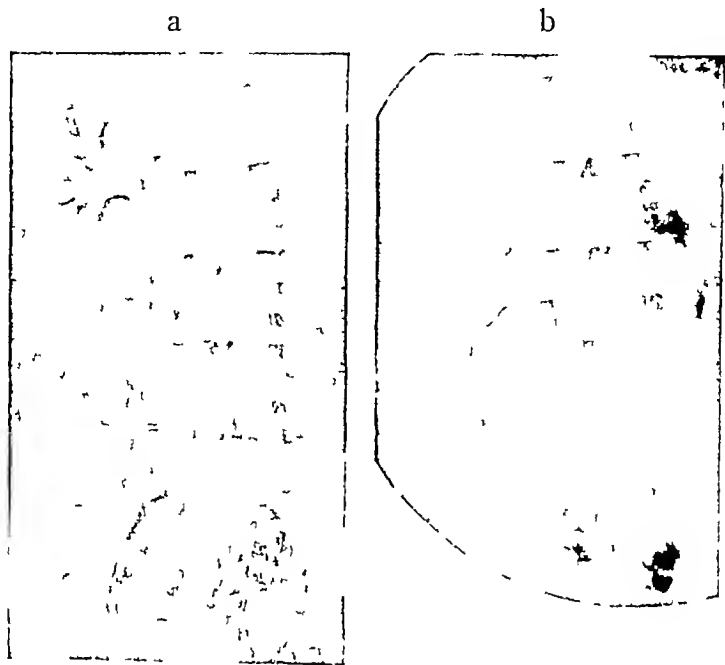


FIG. 135 — (a) Pyelogram made with patient in horizontal position showing little evidence of nephroptosis. (b) Same case as in (a). Pyelogram made with patient in sitting posture demonstrating marked nephroptosis. (Courtesy of Drs. W. F. Braasch and Benjamin F. Hager.)

Stereoscopic exposures may be useful in determining whether a given shadow is intra- or extraureteral. This method is less often used, at present, since the introduction of descending (excretory) urography.

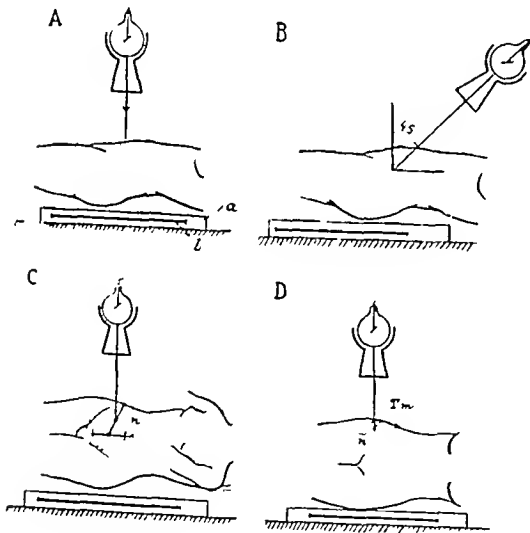


FIG. 136 — Changes in position of the tube and of the patient in making exposure of bladder (after Blanc and Negro).
A Direct anteroposterior
B Axial projection according to the method of Sgalitzer
C Three-quarters position, patient being turned partly on the side
D Direct lateral position

FOR THE BLADDER (FIG. 136)

- (a) Horizontal, i.e. on back, for anteroposterior views
- (b) Lateral, most often in conjunction with cystography, usually this is a three-quarters lateral exposure

It is not within the scope of this book to discuss the technic of radiography as applied to the urogenital tract, because it is well covered in all of the standard treatises on radiography.

2. RADIOGRAPHY WITH THE AID OF OPAQUE URETERAL CATHETERS

Either opaque ureteral catheters in which the length is marked in centimeters can be used, or plain opaque. Both types have their walls impreg-

ones without such markings are employed

nated with a shadow giving preparation These opaque catheters are especially useful in determining

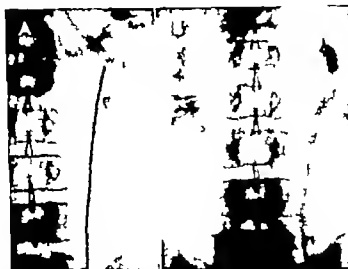


FIG. 137.—A. Relation of shadow of calculus located in renal pelvis to opaque catheter. B. Pyelogram showing inclusion of shadow and indicating location in renal pelvis (left)

(a) The relation of a given shadow to the opaque catheter (Fig. 137) and when combined with urography also to the renal pelvis

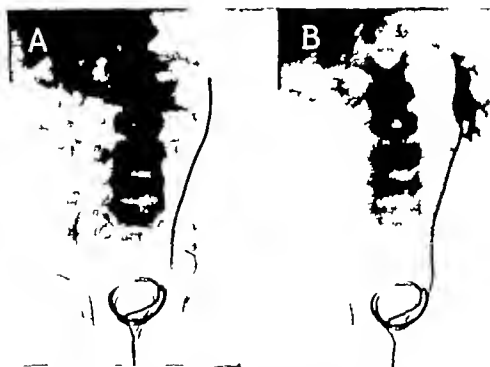


FIG. 138.—Use of opaque catheter and pyelography in differentiation of renal and para renal neoplasm

A. Note displacement outwards of opaque catheter in retroperitoneal sarcoma in girl two years old

B. Note outward displacement and rotation of kidneys in the pararenal neoplasm, also normal appearance of pyelogram

(b) Displacements of the ureter by renal retroperitoneal or peritubercular inflammatory exudates or neoplasms (Fig. 138)

(c) The course and length of the ureters, of especial value in the diagnosis of renal or ureteral anomalies (see Chapter 29)

3 ASCENDING OR RETROGRADE UROGRAPHY

The injection of an opaque medium into the renal pelvis and ureter with the aid of the ordinary type of the ureteral catheter was first suggested by von Lichtenberg and Voelcker in 1906. In the earlier or first period of the development of this method of determining the size, contour and location of the normal renal pelvis and ureter and any changes due to congenital anomalies or pathological changes, colloidal silver or thorium preparations were used. A lack of knowledge of the correct technic² of injecting these solutions was followed by the report of so many accidents that they were abandoned in favor of the halogen salts, as suggested by Cameron, Weld and Rubritius. During the second period, the use of a 12.5 solution of sodium iodide or bromide was the routine procedure in the majority of clinics. Since the introduction of the various preparations, at present employed in descending or excretory urography, the halogen salts are being discarded and there is more and more of a tendency to use *neōskiodan*, *neo-iopax*, *hippuran*, etc., for ascending or retrograde urography. We can warmly recommend their use in the form of a 20 per cent (instead of a 40 per cent strength as used in excretory urography) solution as being followed by less reaction, in the form of pain, and in yielding much more opaque shadows than those given by a 12.5 per cent sodium iodide solution which we formerly used, routinely.

We do not hesitate to inject both renal pelvises at the same sitting, but strongly advise to fill only one pelvis, then make an exposure, followed by the filling of the opposite pelvis, so as to allow time for the opaque medium in the first injected pelvis to escape through the ureteral catheter of its respective side. We never fill both renal pelvises simultaneously, because the reflex symptoms such as nausea, pallor, feeble pulse, etc., although never followed by any fatal termination in our experience, may greatly alarm everyone until some rapidly absorbed cardiac stimulant, like aromatic spirits of ammonia, well diluted is given. The advantages of bilateral urography at the same sitting are manifold. Often a change is found in the urogram of one side which necessitates a comparison with one of the opposite side, but the patient refuses to have another examination made.

Whether a uni- or a bilateral urogram is made by the ascending or retrograde method, we prefer the use of the Bransford-Lewis syringe (Fig. 131) and a relatively small caliber (No. 5 F) ureteral catheter, so as to allow any excess of injected medium to flow back into the bladder alongside of the catheter. The syringe should only be filled with 10 cc. of the opaque medium, which is injected very slowly until a resistance is felt or the patient complains of pain or nausea. It is seldom necessary to aspirate the contents of the renal pelvis, and then only if one has noted that clear or turbid fluid (as in hydronephrosis or pyonephrosis) escapes in a steady stream from the ureteral catheter. After an exposure has been made of one (or in the case of bilateral urography) of the pelvises, the ureteral catheter is withdrawn slowly and a second film exposed to see any changes in the ureters down to their ending in the bladder (see Fig. 145).

If a picture in the upright position is desired, the table can now be raised to the desired angle.

² See section on pnelovenous reflux in this chapter

An excellent method of nuturing the ureters and renal pelvis by the ascending or retrograde technic is to employ the Chevassu ureteral catheter which has an expanded tip so as to prevent the opaque medium in the lowermost portion of the ureter from flowing back into the bladder. It is especially useful for determining the level of strictures, fistulae, etc. of the ureter.

Complications following ascending (retrograde) urography

(a) Anuria. Urography, both uni and bilateral is contraindicated in all cases in which the blood urea content and the tests of kidney function reveal evidences of renal insufficiency. One of us (Eisendrath) saw a case in consultation of anuria following bilateral ureteral catheterization without urography. The anuria lasted about 36 hours. No cases have been reported of such a complication after ascending (retrograde) urography so far as we can ascertain. Wesson (Jour Urol. 1928, 20:355) reported two cases of anuria following the passage of urethral sounds.

b Pyelovenous Reflux. One of us (Eisendrath) reported (Jour Amer Med Asso. 64:128) three series of experiments on dogs which confirmed previous studies by Strassman, Wossidio and Rehn on the effect of the use of excessive pressure in injecting various media (methylene blue, cargentos and collargol) into the renal pelvis. When the pressure with which the fluid was injected remained below 30 mm Hg only an insignificant amount of the opaque medium entered the renal parenchyma or peripelvic tissue. Such a pressure corresponds to the raising of a burette to a height of 34 cm above the level of the table. In the second series when the pressure varied from 30-70 mm Hg the opaque medium (collargol) was found in the kidney tissue, lungs and liver.

When the pressure was raised from 70 mm to 140 mm Hg the animals died of pulmonary embolism within five to thirty minutes. Histologic study revealed the fact that the collargol had entered the renal veins from the pelvis by way of the intertubular spaces. Later investigations by Lee-Brown, Laidley, Hinman, Fuchs, Traut, Bird and Molse, Morison and others, have shown that the pathway by which the pelvic contents enter the venous circulation of the kidney is through ruptures at the tips of the fornices of the calices. The pelvic contents may only enter the peripelvic and perirenal tissue and spread upwards along the fibrous tissue between the pyramids or if the intrapelvic tension is excessive, the contents may enter the plexus of veins surrounding the bases of the papillae.

The three general routes of such a backflow are pyelovenous, tubulovenous or lymphatic and interstitial. Tubular backflow gives a characteristic tuftlike appearance whereas the interstitial types show as irregular streaks or subcapsular accumulation. When toxic media (collargol, cargentos, thorium nitrate) were used deaths were reported due to the medium entering the general circulation. There is no danger in using the nontoxic media mentioned above but one cannot insist too often that in injecting the renal pelvis the pressure should never exceed 30 mm Hg. Even then pyelovenous reflux was found by D. E. Scott (Jour Urol., 1933:30:39) to have taken place in 25 per cent of 162 urograms at a pressure of 30 mm Hg (equal to raising the burette to a level of 34 cm).

c. Injection of the Perirenal Lymphatics. This has been found to occur following ascending (retrograde) urography in 13 reported cases by Abeshouse (Amer Jour Surg. 1935:25:427). It can occur in the absence of any demon-

strable chyluria It does not appear to bear any relation to the use of excessive pressure and consequent overdilation of the renal pelvis In a personal case (Eisendrath) the urogram was made during a search for the source of a hematuria, the same pressure being employed as in many other cases in which such an injection of the perirenal lymphatics did not take place

4 EXCRETORY OR DESCENDING UROGRAPHY

For many years, efforts had been made to find some nontoxic compound which in being excreted by the kidney would yield a shadow of the upper urinary tract Through the investigations of Binz, Lichtwitz and Swick, such a compound was found, containing 42 per cent of iodine by weight and possessed of a high degree of radio-opacity The first clinical application of this new method of diagnosis was reported by von Lichtenberg and Swick in 1928

The evolution of excretory, or intravenous urography as it is termed, has been very rapid The first preparations for intravenous injections were soon improved upon, so that at present, we have at our disposal neo-iopax (Perabrodil), neoskiodan (uroselectan B), Diodrast and hippuran, the last named recently (1933) proposed as a substitute for the other three

Although it was at first maintained that excretory urography would supplant the retrograde or ascending method of outlining the upper urinary tract, this has not been the case That this recent addition to our diagnostic resources is a very valuable one in certain cases cannot be denied, but as our experience with it increases, we find that it also has its pitfalls, so that it is often necessary to complete the examination by the older retrograde or ascending method We will attempt to evaluate excretory urography in an unbiased manner, pointing out its advantages and the necessity of being familiar with its pitfalls

Technic This does not differ from that of any other intravenous mode of administration of drugs, anesthetics, etc In order to better outline the veins at the bend of the elbow, the circulation is temporarily obstructed by a rubber tube around the arm at the level of the middle of the humerus The constricting tube is so arranged that its limbs can be quickly released as soon as the needle has entered one of the larger veins at the bend of the elbow Care should be taken not to use a needle with too acute a tip so as to avoid puncturing the vein The escape of the opaque media into the cellular tissues is very painful and is apt to be followed by local venous thromboses The ampule containing 20 cc of the opaque medium, should be kept in tepid water until one is ready to aspirate its contents into a 20 cc glass syringe As soon as the vein has been entered by the special intravenous needle, the syringe, filled with the opaque medium, is connected with the needle and the solution injected very slowly Occasionally, the patient complains of pain in the shoulder

The first film should be taken five minutes after the injection has been completed, and three or four others at intervals of five minutes We have found that it is more convenient to have the excretory urography precede any other examination, except that of making a plain film or "flat plate," i.e. plain or simple radiography immediately prior to injecting the opaque medium It is advisable to have the bladder empty, for upper urinary tract pictures Fuchs has shown that the fuller the bladder, the less active is renal excretion

Advantages and Indications for Excretory Urography

(a) **AS A GENERAL ORIENTATION METHOD** When excretory urography was in the first period of its evolution the claim was made that it would outline the upper urinary tract i.e. both renal pelvises and both ureters. It was soon found that all of these expectations could not be fulfilled. In the first place it is far from the rule to see the entire length of one or both ureters in an excretory urogram unless there is some form of obstruction or dynamic disturbance in the ureter itself or distal to it. Secondly there may be an absence of any opacity in the kidney region under certain conditions to be mentioned under pitfalls. If these exceptions are borne in mind it must be granted that excretory urography yields much information of a general nature such as the location of the kidneys the presence of anomalies, relation of shadows within or external to the urinary tract, presence of hydronephrosis etc.

We have found that excretory urography does not prolong to any material degree the time needed for a complete urological study of a patient and may greatly shorten it.

(b) **WHERE CYSTOSCOPY OR URETERAL CATHETERIZATION OR BOTH ARE IMPOSSIBLE OR CONTRAINDICATED** There are a number of pathologic conditions in which a cystoscopic examination is either difficult or contraindicated even with the aid of sacral, spinal or general anesthesia. As examples may be mentioned very narrow urethral stricture advanced tuberculous cystitis acute pyelonephritis, acute ureteral block recent kidney injuries ureterovaginal fistula acute cystitis of nontuberculous origin and exstrophy of the bladder.

As to its advantages over the retrograde method in children there is still some difference of opinion. Campbell (*Jour Urol* 1934 32 55) states that too much should not be expected of excretory urography in children. The urograms were of diagnostic aid in only two thirds (67 per cent) of the cases. Although operation may be done on the evidence furnished by excretory urography in calculus and hydronephrosis when these data are definite according to Campbell a more complete examination is advised in children at least.

(c) **AS A METHOD OF POSTOPERATIVE CONTROL** Excretory urography is being more and more employed as an unequivocal method of determining the results of nephropexy and transplantation of the ureters.

(d) **IT IS OF GREAT VALUE IN SETTLING THE QUESTION** of the role played by strictures and kinks of the ureter. It has been shown that spasm of the circular muscles of the normal ureter may simulate a stricture and that ureteral kinks are not infrequently in individuals without symptoms referable to the side upon which they are found.

Disadvantages, i.e., Pitfalls in Excretory Urography

1 **FAILURE TO VISUALIZE RENAL PELVIS** This may occur under both normal and pathologic conditions.

(a) If the kidney is normal but excretion takes place so rapidly that no shadow is to be seen.

(b) If there is such extensive destruction of the renal parenchyma that excretory power is minimal. We shall see below that this is of importance to know in cases of renal tuberculosis tumors etc.

(c) There may be an absence of a shadow as the result of transitory reflex inhibition of renal activity. In sudden blocking of the outlet of the renal pelvis

or of the ureter by a calculus there is often an absence of visualization of the renal pelvis until the obstruction has been relieved. In cases of hyperacute infection of the kidney, there may be an absence of any shadow on the affected side, as the result of a reflex inhibition. In a personal case of hydronephrosis, there was complete absence of visualization, owing to almost complete disappearance of the parenchyma.

2 AS A TEST OF RENAL FUNCTION Although the claim was made during the first period of the evolution of excretory urography that it would be of great value as a function test, this has not proven to be the case. Beer, Rubritius, Lauber and others maintain that the method is of little if any value as a test of renal function. An effort has been made recently to compare the results of excretory urography with indigocarmine, as function tests, by Braasch and Emmett (*Jour Urol*, 1936, 35, 630). In 39 (78 per cent) of 50 cases, the two were in agreement, i.e. the delayed visualization and diminished indigocarmine excretion were the same. In the other 11 (22 per cent) of the 50 cases, the two tests did not agree. In nephro- or ureterolithiasis, the reflex inhibition of renal function plays a role in some cases, in others not. In chronic pyelonephritis, excretory urography gives a good indication of function. In polycystic kidney, indigocarmine is better. In tuberculosis, excretory urography cannot be employed to determine the degree of renal involvement. In renal neoplasms, there is a tendency to diminished visualization, hence if there is little deformity, one can assume that extensive destruction exists.

3 FAILURE TO VISUALIZE MINOR CALICES AND OTHER FINER CHANGES This was pointed out by one of us (Eisendrath) in a recent article (*Brit Jour Urol*, 1935, 7, 124). In a case in which the question arose, as to whether a renal tuberculosis existed, the pelvis and major calices were well visualized but there was complete absence of that of the minor calices, where one is most apt to look for early tuberculous changes.

This is also true of cases of small neoplasms of the kidney, in which information is wanted as to deformities of the minor calices.

Excretory Followed by Retrograde Urography

It is evident that one cannot always secure sufficient information in all cases, from excretory urography alone, upon which either to make a diagnosis or risk an operation. As stated previously, the excretory method yields much information, in the way of orientation, which it was impossible to obtain before its introduction, without ureteral catheterization. To depend upon this method entirely has already, according to reported cases, and will in the future lead to the removal of normal kidneys, hence it should in nearly every case, in our opinion, be supplemented by the retrograde method of urography. Wesson has proposed introduction of ureteral catheters before the employment of excretory urography. This does not appeal to us, because if the claims of von Lichtenberg, Heckenbach and others that excretory urography gives valuable information as to the dynamics of the upper urinary tract, are true, it seems irrational to introduce a factor, like the presence of ureteral catheters, which cannot help but interfere with the normal physiology of the upper urinary tract.

The diagnostic aid which excretory urography yields in the conditions which interest urologists will be taken up in the individual chapters.

INTERPRETATION

Aids in the Interpretation of Normal Urograms

SHADOW OF KIDNEY AND NORMAL PYELOGRAMS Quite often it is possible to obtain the shadow of the normal kidney on plain films (Fig 134) but the absence of a shadow is not to be interpreted as indicating the absence of the respective kidney. The hilus of the normally located kidney is to be found between the transverse processes of the first and second lumbar vertebrae. A shadow (Fig 139) in this location is frequently due to a calculus at the uretero-pelvic junction.

FIG. 139



FIG. 139—Most frequent location of shadow of a renal calculus, located at junction of renal pelvis and ureter.

FIG. 140

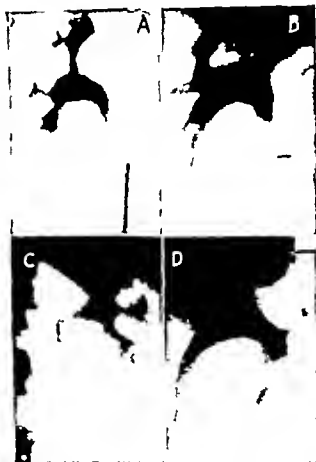


FIG. 140—Normal pyelograms illustrating various types of horizontal pelvises.

of the corresponding kidney.

Types Normal pyelograms are subject to much variation and a knowledge of this fact is of great importance in their interpretation. There are two basic types of renal pelvises.

(a) The ampullary or horn shaped type. This constitutes about 90 per cent of all cases, presenting a pelvis proper, superior, middle and inferior, major and a variable number of minor calices. The long axis of such a pelvis may be horizontal (Fig 140) or vertical (Fig 143). The pelvis proper may form the greater portion, the calices being rudimentary or vice versa, the pelvis proper very small and the calices relatively large (Fig 141).

(b) The bifid type. Here the ureter bifurcates at or before or shortly after

its entrance into the renal sinus into two major calices, without the formation of a pelvis proper. There are many variations of the bifid pelvis (Fig 142). There is

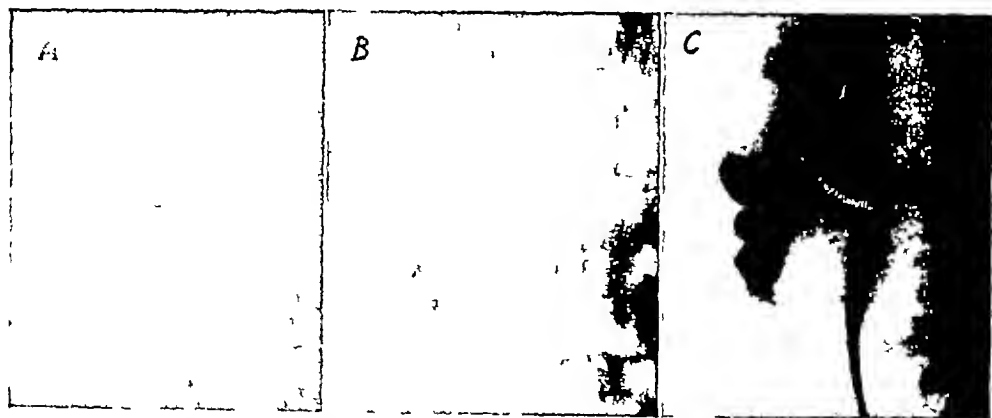


FIG 141—Three pyelograms illustrating a normal variation of ampullary pelvis. There is a predominance of the major calices over the pelvis proper.

found at times a type of normal pelvis which we have termed “pseudospider” with long, narrow calices, greatly resembling the pyelographic deformity seen in renal neoplasms.

The Normal Ureterogram

The normal narrowings with intervening spindle-like dilatations of the normal ureter must not be interpreted as due to strictures. These narrowings and dilatations are very evident in ureterograms of infants and young children (Fig 144). The narrowings persist into adult life more frequently than the spindle-like dilatations (Fig 145).



FIG 142—Unusual type of human pelvis showing almost immediate division within hilus of pelvis into two main portions, a frequent finding in bifid types of pelvis.

The normal levels of the narrowings as seen in ureterograms are

- (a) At the beginning of the ureter, i.e. just distal to the ureteropelvic junction
- (b) Where the ureter crosses the iliac vessels
- (c) In the juxtavesical portion, i.e. just before entering the bladder wall
- (d) In the intramural portion of the ureter

The locations of the normal wider areas or spindles are

- (a) Lumbar region between the above mentioned two levels of normal narrowing
- (b) Pelvic region between the level where the ureter crosses the iliac vessels and its juxtavesical level of narrowing

The levels at which these normal narrowings and dilatations are found vary. They may be higher or lower. Instead of two spindles, there may be only one.

Kinks in the Normal Ureter

An observation of much clinical interest is the occurrence of kinks, i.e. reduplication or elbow like bends as seen in ureterograms of individuals without any symptoms on the side of the body (Fig 146) where they are found. The kidneys are normally located. Whether they have an abnormal range of mobility can only be determined in taking a second picture in the upright position. Such kinks can be produced by the ureteral catheter (Fig 147)

Spasm of the Musculature of the Renal Calices or of the Ureter

Spasm of the musculature surrounding a minor calyx may give rise to a filling defect simulating that seen in a neoplasm. This is especially apt to lead to an erroneous diagnosis if the filling defect is seen in a patient whose chief clinical complaint is hematuria. Such filling defects due to muscular spasm usually of a



FIG 143—Unclassifiable (bizarre) normal pyelograms.

A. From case in which there was a hypernephroma on the opposite side.

B. From case in which there was hematuria due to chronic nephritis on the opposite side.

C. Almost vertical pelvis.

minor calyx, are shown in Figs 148 and 149. In such a case in order to avoid error in diagnosis, it is advisable either to repeat the ascending urography at intervals of several weeks or to employ excretory urography.

Schiffer (Abstracts Zeit. Urol Chir 1936 42 274) recently reported a case of filling defect of the superior major calyx in a patient with colic and hematuria. A pyelogram five days later revealed a perfect filling of this calyx. In the interval between the two examinations the patient passed a small calculus.

Another case has been reported in which such a filling defect due to muscle spasm disappeared when an excretory urogram was made.

Muscular spasm can also occur at any level of the normal ureter as the result of localized contraction of its circular muscle (see Physiology of Ureter) and this must be kept in mind in the interpretation of a ureterogram, lest an erroneous diagnosis of stricture be made. Here it is also advisable to repeat the examination preferably with the use of the Chevasse catheter.

Filling Defects or Deformities of the Pyelogram due to Blood Clots or Inflammatory Exudates

Although we are speaking of normal urogram in this section of the chapter on

Radiography, it is well to direct attention to the fact that a filling defect or a deformity of the otherwise normal pyelogram may be due to the presence of a blood clot or to an inflammatory exudate in the pelvis or calices. This led to the erroneous diagnosis of a neoplasm in a case of thrombosis of the renal vein (see Chapter 34)

5 CYSTOGRAPHY

This is the term applied to the visualization of the bladder cavity and its

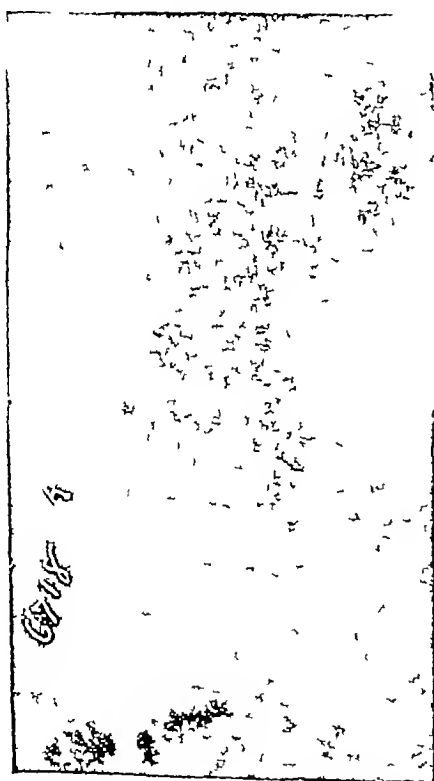


FIG 144 —Bilateral pyelogram made at autopsy of male infant, age ten months. Cause of death meningitis. Urinary history and urine negative. Kindly loaned by Dr Clayton F Smith

FIG 145 —Ureteropyelogram showing variation in caliber of various portions of the normal ureter. Note narrowing just below point of junction of ureter and renal pelvis, followed by the lumbar enlargement or spindle, then a second narrowing where the ureter crosses the iliac vessels and a second or pelvic spindle, this being followed by the juxta-vesical narrowing before entering the bladder wall.



wall by the aid of contrast (opaque) media injected through the urethra or less commonly with the aid of excretory urography

(a) **Plain Film (flat plate)** The film is exposed with the patient lying flat upon the back i.e. an anteroposterior view (Fig. 136). The chief object of such a plain radiography is to detect the presence of calculi or foreign bodies lying in the bladder lumen or in a diverticulum. This method is also of great aid in the diagnosis of prostatic calculi. It must not be forgotten that calculi may be present which do not yield a shadow on the plain film, yet can be seen on cystoscopic examination.

(b) **Cystography With the Aid of a Contrast (opaque) Medium.** A contrast (opaque) medium is injected through a soft urethral catheter into the bladder. Not more than 150 cc. is necessary in the majority of cases and one should not exceed 250 cc. of the solution. Some urologists prefer 5 per cent silver iodide, others 12.5 sodium iodide 25 per cent sodium bromide or 5 per cent barium sulphate solution. We routinely employ a 10-12 per cent solution of neosho-dan. It is less irritating than the sodium iodide or bromide solutions.



FIG. 146—Kinks of the ureter as seen in individuals without symptoms on the side on which the ureterogram was made.

lying on the back i.e. an anteroposterior view (Fig. 136) and the other with the patient only (30 degrees) on the side so that the pelvis is rotated to an angle of 45 degrees with the table the under leg being flexed and the upper extended backwards. The filling of the bladder with a contrast (opaque) medium will in some patients reveal the presence of a reflux (vesico-ureteral) of the bladder contents into one or both ureters and renal pelves. We have observed this in cases of neurogenic dysfunction of the bladder in chronic infections of the bladder and upper urinary tract, in prostatic hypertrophy and in neuro-

genic dysfunction of the upper urinary tracts in children. It has also been noted in cases of congenital valves of the posterior urethra. As a rule such a reflux does not take place in normal bladders. Cystography with the aid of a contrast medium will at times reveal the presence of an enterovesical umbilicovesical or of a vesicodiverticulovaginal (Swartz, Jour Urol 1937 37 518) fistula. The method alone is also of great value in visualizing the presence of small and large diverticula and in the determination of the extent of involvement of the bladder wall in neoplasms or the relation of a calculous shadow to the bladder or a calculus lying in a diverticulum. The variation in contour of the normal bladder is well seen in Fig. 39.

The dome of the bladder becomes more and more compressed as pregnancy advances.



FIG 147—How one can be deceived in regard to the presence of a ureteral kink unless the catheter has been withdrawn. In the left illustration the catheter has artificially kinked the ureter. Note how kink disappears upon withdrawal of catheter as in right-hand illustration.



FIG 148—A Filling defect in right pyelogram due to muscular spasm. Compare with pyelogram of same patient seen in B and with Fig 149. Note narrowing in pelvic portion of right ureter which disappears in B.
B Pelvis and right ureter of same case have been filled more completely at an examination ten days later.

(c) **Cystography With the Aid of Air** Cases of air embolism ending fatally have been reported by Mathé (*Jour d'Urol* 1929, 28, 163) and Jockisch (*Zbl Chir* 1930, 1795) following insufflation of air into the bladder. In both cases, air was employed to distend the bladder instead of a liquid, as a preliminary procedure in suprapubic cystostomy.

Hinman suggested a method for

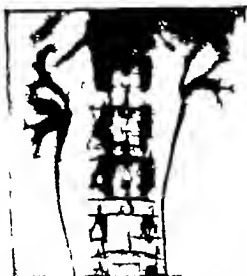


FIG. 149—Pyelograms (bilateral) of same case shown in Fig 148 but taken about one month later showing that filling defect of Fig 148 has disappeared.



FIG. 150—Cystogram showing filling defect (to which arrow points) in a case of infiltrating carcinoma of the bladder.

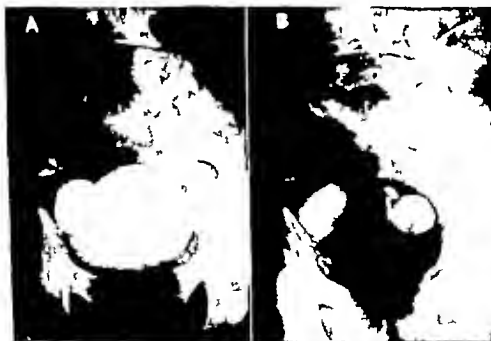


FIG. 151—Hinman method of determining location, size and emptying time of diverticula. (Courtesy of Dr. Frank Hinman.)

A. The bladder filled with opaque solution showing a single large diverticulum on right lateral wall.

B. Exposure made after opaque medium has been allowed to escape from bladder and the latter filled with air. Note two diverticula: the second on left posterolateral wall.

visualizing diverticula of the bladder which includes two steps. In the first, an exposure is made of the bladder filled with a contrast (opaque) medium as

described in the preceding section. The medium is then evacuated and the bladder filled with air. The diverticula, still opaque as the result of a retention of the contrast medium, stand out prominently against the air-filled bladder (Fig 151). This combined opaque medium method followed by air insufflation is still extensively employed in visualization of diverticula, the degree of prostatic enlargement (Alcock) and of bladder neoplasms (Pfahler). No deaths have as yet been reported following the use of this combined cystographic technic, but it is well to be cautious in its application to the diagnosis of bladder conditions.

We have been well satisfied with simple visualization of the bladder by an opaque (contrast) medium, and then after emptying the bladder making a second exposure, to observe the size, location and emptying time of any diverticula.

Cystography with the aid of excretory urography has been employed by Beer for estimating the residual urine following spontaneous emptying of the bladder in prostatic hypertrophy. It is also useful according to G. J. Thompson in revealing filling defects in bladder neoplasms. Canigiani (*Zeit Urol Chir* 1933, 36, 172) has been able to visualize urteroceles with the aid of excretory urography. We have utilized excretory urography in the diagnosis of rupture of the bladder.

6 URETHROGRAPHY

Visualization of the urethra has been greatly simplified during recent years. The opaque medium which appears to give the most satisfactory images of the normal and pathological urethra is Lipiodol, which contains 40 per cent of iodine.

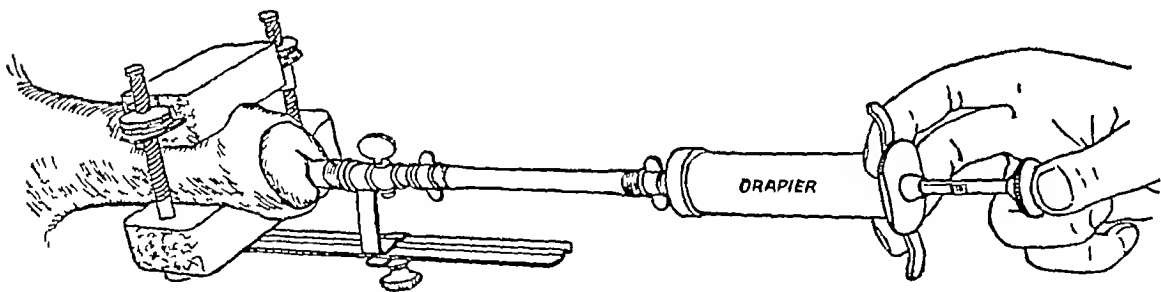


FIG 152—The Moret apparatus for Urethrography. The penis is fixed by the crude rubber pads. A short woven silk or soft rubber catheter is attached to a 10 cc metal syringe filled with Lipiodol solution. The filling of the urethra is carried out under fluoroscopic control.

The apparatus (Fig 152) devised by Dr. Francis Moret of Paris, France, and in daily use at the clinic of Prof. Chevassu can be warmly recommended. The opaque medium is injected under fluoroscopic control, only about 10 cc being employed using very little pressure, so as to avoid entrance of the medium into the veins. One film is exposed with the patient in the horizontal position and a second, with the body forming an angle of 45 degrees with the table. In the latter position the thigh of the patient which is in contact with the table is markedly flexed and the other slightly hyperextended. Injection of the medium into the veins can always be avoided, if slight pressure is employed and the injection is carried out under fluoroscopic control.

The penile urethra is visualized as a straight canal of uniform caliber, which enlarges at the bulb and then gradually decreases in caliber to the narrower membranous portion (Fig 153) corresponding to the location of the external sphincter.

The verumontanum is seen as a clear area in the posterior urethra. The prostatic urethra is visualized as a straight canal extending as such to the vesical orifice. A spasm of the external sphincter may prevent the opaque medium from entering the posterior urethra. Visualization of the urethra in stricture cases is an aid to the instrumental examination. The dilatation of the bulb behind a stricture is particularly well seen in urethrograms. Fistulae of the urethrae and dilated

FIG. 153

prostatic glands are better visualized by this method than by any other. In prostatic hypertrophy involving the lateral lobes the posterior urethra is most often seen to be elongated and compressed by the encroachment on its lumen so that its image resembles that of the scabbard of a sword.

FIG. 154



FIG. 153.—Urethrogram from case of chronic prostatitis with multiple diverticula radiating from the prostatic urethra (Courtesy of Prof M Chevasu) 1 Bladder 2 Prostatic urethra showing multiple diverticula 3 Membranous urethra 4 Bulbous portion of urethra

FIG. 154.—Injected seminal vesicle and vas deferens to show relation to each other

7 SEMINAL VESICULOGRAPHY AND RADIOGRAPHY OF THE EPIDIDYMIS

The Normal Seminal Vesicle Ampulla and Vas Deferens. These can be readily injected through a vasotomy incision¹ in the scrotum. The entire vas ampulla seminal vesicle and ejaculatory duct of each side can be readily visualized (Figs 154 155 and 156) both fluoroscopically and on films. For this purpose we employ 40 per cent Iodipin or Ipiodol. Injection of the seminal vesicles and vas through the ejaculatory duct is very difficult because of variations in the anatomy and anomalies of the ejaculatory ducts and distortions of the verumontanum. There is also another and more important factor. Anything injected into the ejaculatory duct fills up the seminal vesicles and does not enter the ampulla of the vas except in a small percentage of cases. This is analogous to an attempt to fill the

¹ See Chapter 18 on operations on prostate and Chapter 19 on seminal vesicles.

ureter by simple injection of opaque media into the bladder. Except in cases of "reflux," it is impossible to make a ureterogram by injecting into the bladder. The ejaculatory duct is continuous with the seminal vesicle and the ampulla of the vas

FIG 155A

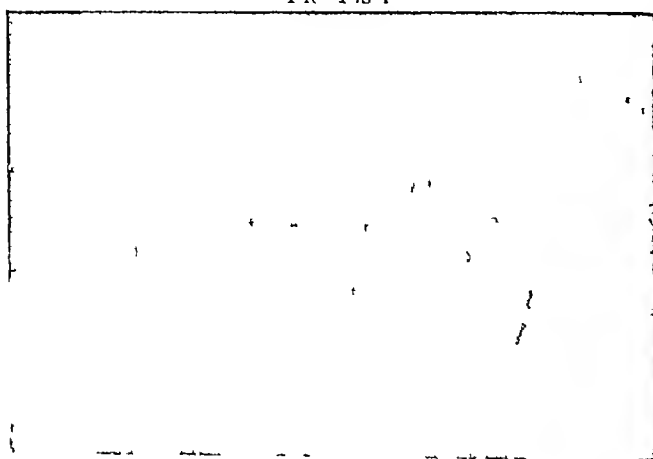


FIG 155B



FIG 155A—Normal vas and seminal vesicles filled with iodized oil through vasotomy. The vesicle fills before the fluid passes out through the ejaculatory duct, hence vesicle must be considered as a reservoir for spermatozoa (See Chap. III)

FIG 155B—Relation of vas and vesicles (filled with iodized oil) to ureters. Both renal pelves have been filled with 1.5 per cent sodium iodide solution. opaque catheter still in right ureter

enters the neck of the seminal vesicle obliquely just as the ureter passes through the bladder wall. There is either a valve or sphincter at this point which prevents regurgitation.

The ampulla of the vas and the seminal vesicle do not unite to form the ejaculatory duct (See Chapter 2 on Anatomy)



FIG 156—Bilateral epididymogram. Iodized oil forcibly injected downward in living subject through vasotomy fails to pass beyond the tail of the epididymis, no pain during injection nor irritation afterward

Radiography of the Epididymis This may be indicated in certain cases and in the future may prove to be of considerable value. This is carried out through a vasotomy incision. The contrast fluid is injected downward (distally) instead of toward the posterior urethra, as in making a vesiculogram. No harm can result

from this procedure unless highly irritating contrast media are used. Iodipin or lipiodol both in 40 per cent strength, are excellent media for this purpose. It is impossible to inject beyond the tail (Fig. 156) of the epididymis.

The application of this method for diagnostic purposes is considered in Chapter 51 on Operations for Sterility.

Some urologists even apply to the urine the same method of counting as is used for red corpuscles and leukocytes in blood specimens, viz, so and so many per cubic millimeter. We think that such a refinement of laboratory diagnosis is seldom necessary from a clinical standpoint.

I C Reaction of the Urine

Normally, the mixed 24-hour urine is slightly acid in reaction. The acidity was formerly held to be due wholly to acid phosphates but Folin³ has shown that the acidity of a clear urine is ordinarily greater than the acidity of all of the phosphates, the excess being due to free organic acids. Individual specimens may be slightly alkaline, especially after a full meal, or they may be amphoteric, turning red litmus paper blue and blue paper red, owing to presence of both alkaline and acid phosphates. The reaction is ordinarily determined by means of litmus paper, which must be of good quality.

Determination of Hydrogen-ion Concentration³ The hydrogen-ion concentration or true reaction of the urine is ordinarily about pH 6, with the normal range of 4.8 to 7.5. Simple outfits for the determination of hydrogen-ion concentration colorimetrically can be purchased from the chemical supply houses. Dilute the sample of urine with distilled water if too highly colored. The phosphates in the urine act as a natural buffer. Place 10 cc. of the sample in a pyrex test tube, 16 mm. internal diameter. Add 0.5 cc. of 0.04 per cent solution of bromthymol-blue, which has a range in its color changes from 6.1 to 7.7. If the urine is acid, less than 7, use brom-cresol-purple, 5.4 to 7, and if alkaline use phenol red, 6.6 to 8.2. If the urine is very alkaline use thymol-blue, 8.2 to 9.8, and if very acid use chlorphenol-red, 5.1 to 6.7. The colors are readily matched by referring to a color chart now generally used for this purpose, or by using a comparator.

BACTERIOLOGIC EXAMINATION OF THE URINE

This includes (a) the examination of a stained smear made from the centrifuged sediment, (b) the inoculation of this sediment upon various culture mediums, and (c), in certain cases, the inoculation of animals (guinea-pigs, rabbits, mice and fowl) with the centrifuged sediment.

1 Examination of Stained Smears of the Centrifuged Sediment

For this purpose, the Gram method of staining is a most convenient one for rapid orientation as to the presence of the type of ordinary pathogenic organisms. In order to search for the tubercle bacillus, special methods of staining are necessary.

Certain organisms when stained and afterward treated with a solution of iodine and washed in 95 per cent alcohol give up the stain, others retain the color. These latter are said to be "Gram positive" or "to stain by the Gram method." Those losing the stain are "Gram negative" but if a counterstain, such as safranin or neutral red, is used they can be rendered visible (see Plate III).

The Gram method permits placing the bacteria most commonly found in nontuberculous infections of the urogenital tract in the male and of the urinary tract in the female into two groups, as follows:

³ From, Todd and Sanford. *Clinical Diagnosis by Laboratory Methods*, Philadelphia, W. B. Saunders Co., 1937, p. 81.



PLATE III

A Film from gonorrheal pus (Muir) stained with eosin and methylene blue (Muir)

Cocci are arranged in pairs and are seen lying free but are usually intracellular and stain a deep blue (upper left) In the lower half the pus was stained by the Gram method The gonococci are seen to have lost the original blue color, i.e. are Gram negative and to have stained deeply with the counterstain (neutral red) In left lower portion, one sees appearance of gonococci in culture

B Ducrey Unna bacillus as seen in chancroids (Muir)

In upper half is a film from a young agar culture stained by the Gram method

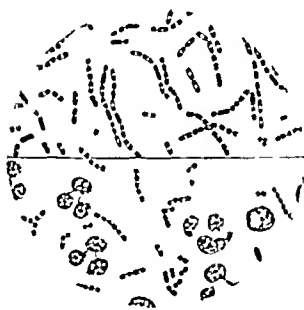
In lower half is smear from chancroid Note the short oval bacilli arranged in pairs with tendency to form chains Methylene blue stain

C *Bacillus coli* from case of cystitis, stained by Gram's method and counterstained by neutral red

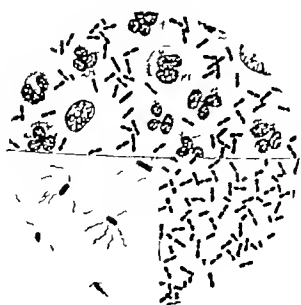
Upper half shows bacilli in pairs end to end The organisms have lost the original violet stain and taken up the neutral red, i.e. are Gram negative In left lower quadrant is a culture stained for flagella In the right lower quadrant is a young agar culture stained with methylene blue



A



B



Gram positive

Staphylococci
 Streptococci
Micrococcus ureae
 Smegma bacilli
 Pneumococcus

Gram negative

The *Bacterium-coli* group
B. pyocyaneus
B. proteus
 Salmonella group
 Gonococcus
Micrococcus catarrhalis

Many modifications of the Gram stain have been devised. One of the best is that of Burke (Jour Bact., 1922 7 159) according to Jordan

- A. Air-dry thinly spread film and fix with least amount of heat necessary to kill the organisms and fix them to the slide.
- B. Flood smear with 1 per cent aqueous solution of the dye (carbolic gentian violet) to be used. Mix 3-8 drops of a 5 per cent solution of sodium bicarbonate with the dye on the slide and allow to stand 2-3 minutes.
- C. Flush off the excess stain with the iodine solution (1 Gm. iodine, 2 Gm. potassium iodide, 100 cc. distilled water) cover with fresh iodine solution and let stand one minute or longer.
- D. Wash in water for 2-3 minutes and blot off all free water until surface of film is practically free of water but do not allow film to become dry.
- E. Decolorize with acetone or acetone and ether (1 part ether to 1-3 parts acetone) until decolorizer flows from slide practically uncolored. This usually requires 10 seconds.
- F. Blot dry. The slide dries quickly without blotting.
- G. Counter stain for 5-10 seconds or longer if desired with a 2 per cent aqueous solution of safranin O.
- H. Wash off excess stain by short exposure to water blot and dry. Immerse in xylol or turpentine for several minutes or until clear. Examine.

STAINING OF TUBERCLE BACILLI

After prolonged (thirty minutes at least) centrifugalization of the urine preferably collected directly from the kidney either the original Ziehl-Neelsen (Centralbl Bakt., 1891 10 273) or the Jones (Jour Amer Med Assoc 1924 83 1917) method can be used.

TECHNIC OF THE ZIEHL-NEESEN (CARBOL FUCHSIN) STAIN

The stain is composed of basic fuchsin 1 part absolute alcohol 10 parts 5 per cent solution carbolic acid 100 parts

- A. Flood the slide with the solution and heat gently over the flame until the film seems deeply stained.
- B. Wash and decolorize with a 2 per cent solution of hydrochloric acid in 80-95 per cent alcohol. It is well to decolorize until the thinner portions of the film show no red color.
- C. Wash in water.
- D. For a contrast stain, use methylene blue.
- E. Wash and examine.

TECHNIC OF JONES METHOD

Centrifuge urine at low speed for 2-3 minutes. One half of the supernatant liquid is poured off and the other half diluted one fourth of its volume with 95 per cent alcohol and another fourth with distilled water. Now centrifuge at high speed for 5 minutes until the supernatant liquid is clear. The latter is poured off, smears made from the sediment and stained by the Ziehl-Neelsen method. Jones maintained that the majority of the bacilli remain in the supernatant liquid having practically the same specific gravity as the urine.

2 Inoculation of Centrifuged Urinary Sediment on Culture Mediums

It is beyond the scope of this book to describe the culture mediums and mode of identifying culturally the various bacteria found in urinary tract infections. These can be found in all of the standard text books of bacteriology.

We wish, however, to call attention to the rapidly increasing importance of the culture method in the detection of tubercle bacilli in the urine. A comparison of the smear, culture and animal inoculation method by one of us, which was published recently (Surg, Gynec and Obst, 1937, 65, page 89 of Internat Abst of Surg) has shown that the culture method has become a laboratory method which can be used routinely, since Loewenstein in 1924 showed that the contamination of culture mediums by nontuberculous organisms can be eliminated by treatment of the urinary sediment with sulphuric acid solutions. The two culture mediums which give the largest number of positive results are (a) the Loewenstein and (b) the Petragagni medium as modified by Dr A Saenz of the Pasteur Institute (Paris).

According to de Carvalho and Corper, as many as 100,000 tubercle bacilli must be present in order to be seen in a smear of the centrifuged urinary sediment, whereas only a few, one to ten bacilli, are necessary to give a positive result with the culture and guinea-pig inoculation methods.

A positive culture can be obtained as early as the fifth day after inoculation of the medium. The average period is from 12-14 days, whereas it is necessary to wait for six weeks to obtain a positive result from a guinea-pig.

The culture has been found to be positive in a number of cases in which the smear was negative.

3 Inoculation of Laboratory Animals with the Centrifuged Urinary Sediment

In the majority of cases of infection of the urinary tract, this method is employed only in the search for tubercle bacilli. There are three distinct types of the tubercle bacillus, which can be readily identified by their cultural characteristics and their pathogenicity toward certain laboratory animals. These three types are the human, the bovine and the avian.

The human and bovine types are pathogenic for guinea-pigs and rabbits but not for fowl, whereas the avian type is nonpathogenic for guinea-pigs, and only pathogenic for the rabbit when massive doses of bacilli are inoculated. The avian type is, however, very virulent for fowl in minute doses. This type is very rarely found in human beings. The guinea-pig is most commonly selected for the inoculation of the centrifuged urinary sediment in the search for tubercle bacilli. As a rule, the subcutaneous method is used, 2 cc of the sediment being injected in the region of the knee-fold. The intraperitoneal method is less often used for clinical work. Following the formation of a nodule at the site of injection, which becomes caseous, there is progressive involvement of the adjacent inguinal lymph nodes (Plate V), then those of the retroperitoneal chain before a generalized tuberculosis develops. Every guinea-pig should be killed within three months, unless death takes place before from tuberculosis.

Clinically it is advisable to use both the guinea-pig and culture methods. The latter excludes the possibility of death from intercurrent nontuberculous infections and from spontaneous tuberculosis which may develop from contact with tuberculous animals. Except in the less common cases of infection by the bovine type of tubercle bacillus, in which the colonies require forty days to

develop (the same time required for a positive guinea-pig test) the culture method is not satisfactory. It is always advisable to inoculate two guinea pigs because one may die of an intercurrent (nontuberculous) infection.

Pitfalls in the Interpretation of Smears and Cultures of Tubercle Bacilli

By prolonged search and good staining methods tubercle bacilli can be found in 85-90 per cent of cases of renal tuberculosis. When acid fast bacilli are found in a smear, it must be certain that every precaution has been taken to exclude contamination by acid fast saprophytes. These have been found on previously used slides on laboratory glassware in tap-water, urine human blood and in chemical reagents used in preparing the solutions. Such acid fast saprophytes cannot be distinguished in smears from tubercle bacilli hence if there is any doubt in a given case it is better to employ both the culture and guinea pig examinations.

Fresh culture medium should be prepared every eight to ten days and from 6-8 tubes should be inoculated with 0.5 cc. of the urine sediment previously treated by the Loewenstein Hohn technic. Inoculation of the tubes should be carried out if possible in a closed room so as to avoid the deposit of acid fast saprophytes present in dust. One half of the inoculated tubes can be kept at ordinary room temperature and the others in the incubator. If there is any doubt about a given colony or colonies being acid fast saprophytes, and not tubercle bacilli it is advisable to inoculate scrapings from such colonies into guinea-pigs. The latter do not present any typical tuberculous changes following inoculation with colonies of acid fast saprophytes.

TESTS OF RENAL FUNCTION

The estimation of renal function includes the following steps

- 1 Biochemical examination of the blood for evidences of retention of nitrogenous end products
- 2 Tests indicating how both kidneys act as a unit i.e. total renal function tests.
- 3 Tests which yield information as to the separate (independent) action of each kidney i.e. separate renal function tests

Before considering these in the order named, we will recall (see Physiology of Kidney in Chapter 3) the fact that the glomerular membrane acts as a simple filter. All crystalloid substances of the blood are found in the same concentration in the glomerular filtrate as in the blood. The colloids, especially the proteins do not pass through the glomerular membrane. A reabsorption of water and different substances takes place in the tubules where the original glomerular filtrate is changed into the definite urine. The kidney also plays an important part in the regulation of the acid-base equilibrium of the blood.

1 Biochemical Examination of the Blood.

Theoretically the evidence of the degree of retention of nitrogenous end products in the blood, is obtained by an estimation of the total non protein nitrogen, urea nitrogen, uric acid and creatinine. Practically the estimation of the urea nitrogen content of the blood is the only one employed in daily practice.

The following figures represent the values obtained in health under ordinary conditions of diet and exercise

Total nonprotein nitrogen	25 to 30 mg per 100 cc of blood
Urea nitrogen	12 to 15 mg per 100 cc of blood
Uric acid	2 to 3 mg per 100 cc of blood
Creatinine	1 to 2 mg per 100 cc of blood

The distinction between urea and urea nitrogen must be kept in mind. One gram of urea nitrogen corresponds to 2.14 Gm of urea. Blood urea is usually recorded in terms of urea nitrogen. To estimate the degree of nitrogen retention, some workers determine the total nonprotein nitrogen of the blood, others rely upon the urea nitrogen alone according to Todd and Sanford.⁴ It apparently makes little difference which of the two (total nonprotein nitrogen and urea nitrogen) is determined, since the results run closely parallel under practically all circumstances. Estimation of urea is much simpler and one of two methods (Folin Wu method with aeration or Van Slyke-Marshall modification of the Marshall Urease methods) are usually employed.

Specimens, usually 10 cc from a vein at the elbow, for the estimation of urea should be taken before breakfast.

The blood-urea content is the best index to the amount of retention of nitrogenous substances in the blood (Bugbee, *Jour. Urol.*, 1928, 20, 541). A persistently high blood urea (over 100 mg) indicates poor renal function if accompanied by a low phthalein output (see later). A normal blood urea alone does not indicate normal renal function. The majority of urologists consider that a blood-urea content over 50 mg per 100 cc indicates faulty elimination. Some raise this minimum to 60 mg. The prognosis as regards a high blood-urea content is better in acute than in chronic retention of prostatics. Under appropriate treatment, a figure as high as 250-300 mg following acute retention, can be rapidly reduced to 60-80 mg or even to normal (30 mg). If, however, the kidney has been more seriously damaged as the result of back pressure alone or combined with infection, the outlook for reduction of the high blood urea by treatment is less favorable.

As to the creatinine content of the blood, its estimation is of less importance than that of urea, unless the latter remains persistently high. A blood creatinine content of 1.5 mg per 100 cc can be regarded as normal. A rise to 5 mg is of serious prognostic significance.

2 Total Renal Function Tests

A large number of these have been suggested, but relatively few are used in everyday urologic work. They are intended to give information as to how the two kidneys act as a unit and are most frequently employed in cases of bladder neck obstruction of all types.

The phenolsulphonephthalein test⁵ is the one most commonly employed as a total functional test and will be described in detail. The others, less frequently used, will only be referred to briefly.

TECHNIC OF USE AND INTERPRETATION OF RESULTS OF PHTHALEIN TEST

The dye can be obtained in ampules containing 1 cc of a 0.6 per cent solution (0.0006 Gm of the dye). The solution is preferably given intravenously, care being taken to inject the entire contents of the ampule.

⁴ Clinical Diagnosis by Laboratory Methods, Philadelphia, W. B. Saunders Co., 1937.

⁵ Usually abbreviated to "Phthalein test."

The time of appearance varies from two to eleven minutes. In 44 tests on 23 normal individuals E. Clay Shaw (*Jour Urol* 1925 13, 575) found that 40 per cent was eliminated in the first 15 minutes, 17 per cent during the second such interval of time, 8 per cent during the third, 4 per cent during the fourth quarter hour and then there is a gradual decrease during the second hour. In general, it is estimated that the total output in the first hour after appearance of the dye averages from 40-60 per cent and that of the second hour, from 15-25 per cent. Pasteur Vallery Radot (*Presse Médicale* Dec. 12 1936) found in studying 75 cases of nephritis and 6 normal individuals with control by other methods, that an elimination equal to or above 25 per cent during the first 15 minutes indicates that it will reach the normal figure at the end of the first hour. If the elimination only attains 20 per cent in the first 15 minutes no deductions can be made and it is advisable to continue the tests for the first hour. A new Young Elvers Phthaleinometer (Fig. 157) greatly facilitates the phthalein estimation.

Young (*Jour Urol*, 1931 26 25) uses a chart on which the appearance time is first noted. The phthalein estimations are made every half hour after injection and also at the same intervals after appearance of the dye for four half hour periods respectively. Thus, the curve of the phthalein output for two hours after injection and two hours after appearance, is recorded. The same chart* serves for various laboratory and clinical data: the blood urea curve showing the inverse parallelism already referred to between the phthalein elimination and blood urea content in cases of prostatic obstruction. We are indebted to Dr. Young for permission to reproduce two typical charts.

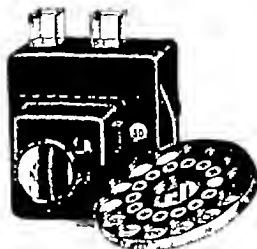


FIG. 15 —A new Young Elvers Phthaleinometer with permanent color discs accurately graduated to read increasing percentages of phthalein of specimen which is carried in square ground glass test tube (a).

If the specimen has a strong urinary color accurate matching may be obtained by placing an equally diluted specimen of urine in the tube (b). The lens to magnify the reading of the parallel planes of color is not shown. The tube which carries the stem of the lens is shown beneath the reading glasses.

The first patient (Fig. 158) had an acute retention from prostatic obstruction with a residual urine of 1000 cc. and the blood urea was 228 mg. per 100 cc. The phthalein test showed an appearance time of 8 minutes but the curve of elimination was bad: being 10 per cent the first half hour, 20 per cent the second, 15 per cent the third and 10 per cent the fourth. Under continuous catheter drainage the blood urea returned to normal and the phthalein began to improve within five days. After 30 days the elimination in the first half hour was 40 per cent.

In the second case (Fig. 159) there was back pressure of long standing due to prostatic hypertrophy. The blood urea on entrance was 130 mg. per 100 cc. and the appearance time of the phthalein was one half hour after injection. During the second half hour there was still only a trace present and during the following three half hour periods only 5 per cent was eliminated each time. The total being 15 per cent in two hours and thirty minutes after injection. Under catheter drainage the blood urea rose to 185 mg. per 100 cc. but rapidly dropped to normal.

The successive phthaleins are charted with dotted or broken lines.

and remained so up to the time of operation. During the same period, the phthalein test showed gradual improvement, the appearance time dropping to 6 minutes.

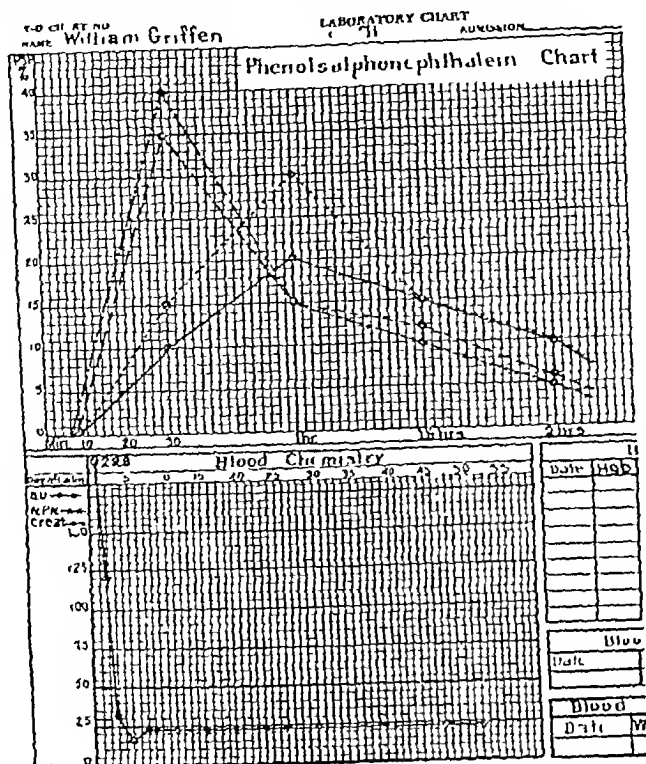


FIG 158—Acute uremia (blood urea 230) in a case of obstruction. Residual urine 1,000 cc. Prostatectomy successful. (Courtesy Hugh H. Young, *Journal of Urology*.)

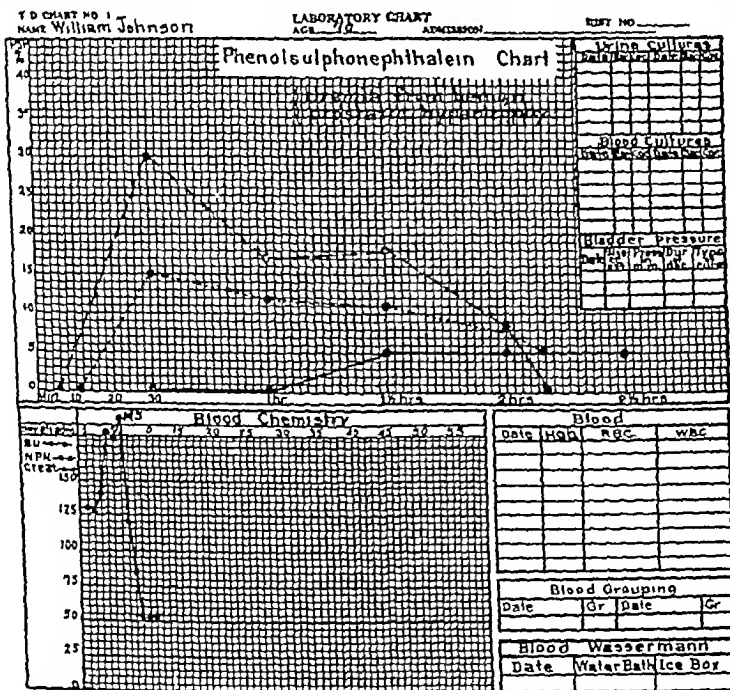


FIG 150—Chronic uremia owing to prostatic hypertrophy. Marked improvement with catheter drainage. Prostatectomy successful. (Courtesy Hugh H. Young, Journal of Urology.)

The elimination in the first half hour rose to 30 per cent and the total curve was an excellent one

We have cited these two cases to show the necessity of phthalein tests and blood-urea estimations being made on the same day and hour, as well as the use of one as a check on the other. Blood chemistry usually demonstrates renal changes at a much later stage according to Dr. Young (loc. cit.) but taken in conjunction with the phthalein test is of great value. By a remarkable inverse parallelism, the two tests furnish a graphic demonstration of improvement under treatment. For more accurate determinations of the phthalein test, Young and Elvers have presented a new phthaleinometer.

The only drawback to the phthalein test is the difficulty of making the estimations if there is much blood in the urine.

Other Total Function Tests. Only brief reference will be made to other tests of total renal function because they are employed but little in comparison to the phthalein test.

Creatinine Excretion Test. This was first studied by R. H. Major and warmly recommended by N. F. Ockerblad (Jour. Urol. 1925, 13: 411). A polyuria is produced by forcing fluids. The urine is collected for one hour to determine the normal rate of excretion for the patient. Then 5 cc. of the buffer solution containing 0.25 Gm. of creatinine with 1 cc. of phthalein is injected intravenously and the urine is obtained by catheterization at 15-minute intervals for two hours. In a later paper (Jour. Urol. 1925, 14: 477) Ockerblad reported his experience as being very satisfactory in 1,000 cases.

Urea Excretion Clearance Test. This test was first described by McLean and still has some enthusiastic advocates. The test can be made in one of three ways: (a) By giving 10 Gm. by mouth. Within a period of six hours the blood urea must have returned to normal. If there is a decrease in renal function the urea given by mouth remains in the blood as long as 24 hours. (b) If 20 Gm. are given by mouth it should all be excreted in 48 hours. (c) This is the most frequent method of application of the test. Following evacuation of the bladder contents 15 Gm. of urea are given in 100 cc. water or in 200 cc. weak coffee. The urine is collected at the end of the first and second hours respectively. The urea concentration in normal cases rises to 2.5 per cent or higher in the second urine. If only 2 per cent is found the renal function can be considered as good but not normal. If it is only 1.5 per cent it indicates a decided decrease in function. The presence of blood does not interfere with the test but that of sugar does. A very favorable report of the use of this test in prostatics was made by Husfeldt and Aalkjaer (Acta Chir. Scand. 1933, 70: 396).

The Volhard Concentration and Dilution Test. This is more frequently employed by certain European urologists like Wildbolz, than elsewhere. It is based on the fact that the amount of urine passed by a normal individual in 24 hours is 1,500 cc. with a specific gravity of 1.020. The patient to be examined by the dilution test is given 1,500 cc. of fluid (weak tea) early in the morning on an empty stomach. The urine is collected every half hour for four hours, the amount and specific gravity of each voiding being noted. The normal kidney excretes 1,500 cc. in four hours, at least half in the first two hours. The specific gravity drops to 1.000. If the mode of excretion changes in such a manner that the major portion of the ingested fluid is not passed during the first hours but is more or less equally distributed so as to be 350-400 cc. every hour, this indicates a slight change in ability to excrete. If the total amount excreted in four hours drops to 200-300 cc. and the specific gravity remains about the same and

not below 1010, a serious disturbance in the filtration power of the kidney can be assumed

The concentration test can be carried out on the following day. No fluids and only dry food can be taken for the 24 hours before beginning collecting the urine at hourly intervals in order to ascertain the specific gravity of each voiding. In normal cases the specific gravity rises to 1025-1030. If it remains below 1020, it indicates a diminished ability on the part of the kidney to concentrate.

Neither the Volhard dilution and concentration tests nor the more recently published Lashmet-Freyberg concentration test (Jour Amer Med Asso, 1935, 105, 1575) have been adopted in American urological clinics and in only a few European ones.

Indigo Carmine as a Total Function Test The use of indigo carmine as a test for combined (both kidneys as a unit) renal function was warmly advocated by the late B. A. Thomas (Jour Urol, 1930, 24, 141) and more recently by Chwalla (Zeit Urol Chir, 1932, 34, 85). Although the use of this dye as a test of separate (individual kidney) function is becoming more and more popular, there has been objection to its use in prostatics for determination of combined (total) renal function. Only 25 per cent of the indigo carmine injected is eliminated through the kidneys. Many hours may elapse before the total elimination is completed, whereas in normal kidneys, 75 per cent or more of the phthalein injected is eliminated within the first two hours.

Excretory Urography as a Total Function Test This has been taken up in the chapter on Radiography.

3 Separate Function Tests

These are employed as a rule in conjunction with ureteral catheterization as a part of the collection of urine from each kidney for chemical, cytologic and bacteriologic study. The majority of urologists, at least in this country, employ the two following separate function tests:

(a) The indigo-carmine test

(b) The phthalein test

The Indigo-Carmine Test The contents of an ampule (Hynson-Wescott or Lilly) containing 6 cc. of a 4 per cent solution of the dye can be injected intravenously or into the gluteal region. We prefer the former method. The typical blue coloration of the ureteral urine appears in 3-8 minutes after injection. If the kidney function is normal, the pale blue initial color changes rapidly (30-60 seconds) to a very deep blue. If the function of the kidney is greatly reduced, this change from a pale to a dark blue color does not take place and the urine retains its pale blue color throughout the period of observation. If the function is only moderately reduced, the change from a pale to a deep blue takes place very slowly, after an interval of 15-30 minutes. One cannot estimate the percentage of indigo carmine which is excreted, as is the case with phthalein, but the interpretation of the various shades of the blue color, indicating normal or poor concentration of the dye in the kidney, is soon acquired. This test of separate function was first suggested by the late Eugene Joseph and its use is increasing rapidly all over the world. It is inadvisable to inject the dye before both ureters have been catheterized, because the blue efflux (Plate XII) from the ureteral orifices, although it may be of aid in finding them in difficult cases, soon discolors the bladder contents to such an extent that it is necessary to

change the fluid by continuous irrigation through the cystoscope. We wait until all urine specimens have been collected for chemical, cystologic and bacteriologic study before having the dye given intravenously by an assistant. As in the case of phthalein the presence of much blood in the urine may interfere with the interpretation of the color of the blue dye. Indigo carmine has the advantage over phthalein of enabling us to dispense with the 10 per cent sodium hydroxide solution which is used to determine the appearance time of the phthalein in the form of a rose color at the point where the urine dripping from the ureteral catheter encounters the alkaline solution.

Taken in conjunction with the blood chemistry findings the indigo-carmin test yields as good results as phthalein. It has the advantage that the cystoscopist is not obliged to wait for a report on the results of the phthaleinometer examination as to the percentage eliminated in a given time but learns to form his own judgment as to the function of the kidneys excreting as independent units.



FIG. 160.—A Large coral calculus in the left kidney.
B Same case. A right pyelogram was made in order to confirm the results obtained after injecting indigo carmine. This indicated a normally formed pelvis but compensatorily enlarged.

The Phthalein Test. The technic of the intravenous administration does not differ from that used preliminary to the total function phthalein test described above. The ureteral urine after specimens have been collected for chemical, cystologic and bacteriologic study is allowed to drop into a small transparent glass receptacle containing a 10 per cent solution of sodium hydroxide. As soon as the latter becomes red at the point of contact of the phthalein and alkaline solution the appearance time of the phthalein is noted. This varies from 3.8 minutes rarely longer in normal individuals. To avoid using a 10 per cent sodium hydroxide solution one of bicarbonate of soda works equally as well.

Objections raised against the accuracy of the phthalein as a separate function test are first that unless ureteral catheters of large size or of an occluding type are used considerable urine escapes along side the catheter and is mixed with that of the other kidney in the bladder. Second unless the phthalein elimination is sufficient in the first or second fifteen minute period following its appearance in the alkaline solution a longer period of observation becomes necessary.

If the cystoscope has been removed and the patient sent back to bed without removing the ureteral catheters which have been led into test tubes or small bottles attached by adhesive tape to the patient's thighs there can be no objection to prolonging the period of collecting specimen for further phthalein estimations otherwise many patients object to lying on the cystoscopic table for more than half an hour.

As far as time of appearance of indigo-carmin and of phthalein is concerned there is no difference i.e. about 3 to 8 minutes in normal individuals. Indigo-carmin has an additional advantage in enabling the cystoscopist to approximately determine the functional capacity of each kidney by the rapidity with which the initial pale blue becomes a deep blue. This takes place within a minute in a normally functioning kidney.

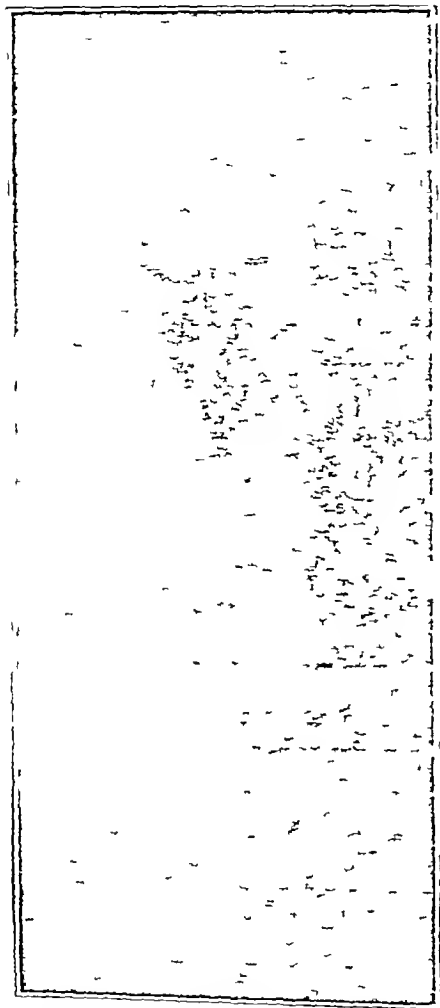


FIG 161—Pyelogram from personal case of congenital lack of development of kidney. Pyelography often gives more information in such cases than functional tests.

Although the phthalein test is the method of choice for total function tests, the number of urologists who employ indigo-carmin for estimating the separate function of each kidney is constantly increasing.

One factor must never be overlooked in the evaluation of the results of separate function tests and that is the remarkable recuperative powers of the kidney. The function may appear to be very much diminished because of the toxic influence of a diseased kidney upon the opposite one. Such a diminished function is usually transitory owing to the ability of this second kidney to eliminate toxins as soon as the source of infection has been removed. For this reason, it is advisable to repeat the separate function tests, as a single estimation does not always suffice. In cases where the function on the side opposite to that upon which the diseased kidney is situated, is greatly diminished, much information can be obtained, we have found, in an ascending urogram if it fails to show any abnormal changes (Fig 160). Although not final, a normal urogram indicates, at least, a relatively slight, if any, involvement of the kidney and this perhaps of only toxic character. If this opposite kidney on several examinations shows a marked decrease in function, but negative chemical, cytologic and bacteriologic findings, then excretory and retrograde urography are indispensable in order to exclude the presence

of a congenital hypoplastic kidney (Fig 161) which is unable to do the work of both kidneys, following removal of the opposite one (see chapter on Anomalies of the Kidneys).

Finally, in some nervous individuals there is such a marked polyuria during cystoscopy and ureteral catheterization, that separate function tests are of little value and the examination must be repeated. In other individuals, there is little if any urine available for function tests as the result of a reflex inhibition of secretion (see Chapter 3, Physiology of Kidney). We have found that if warm water (not exceeding 105°F) is injected in small quantity into the renal pelvis the urine soon appears. If this does not succeed, the patient must be given liquids by mouth in moderate amounts.

CHAPTER 9

ANESTHESIA IN UROLOGY¹

METHODS

GENERAL INHALATION ANESTHESIA
SURFACE (MUCOUS MEMBRANE) ANESTHESIA
INFILTRATION ANESTHESIA AND NERVE BLOCK
ING

REGIONAL ANESTHESIA
SPINAL ANESTHESIA
INTRAVENOUS ANESTHESIA

The choice of an anesthetic is of great importance in urologic surgery. Many older patients with bladder neck obstructions are poor surgical risks. Operations on the kidney are frequently unavoidable even though the general condition of the patient is poor. The urologist has therefore been at the forefront in the use of new anesthetics and new methods of their administration in the attempt to employ the type of anesthesia that will be satisfactory with the least ill effect on the patient. Recent advances have greatly increased the choice of anesthetics. When carefully administered by those who are well trained there is practically no danger involved in the administration of the tried anesthetics by the various routes. It is advisable not to push an anesthetic agent beyond its ordinary limitations but to make use of others as the occasion requires.

METHODS

The following methods of anesthesia are generally employed in urologic surgery:

- 1 General Inhalation Anesthesia
- 2 Surface Anesthesia
- 3 Local Infiltration and Block Anesthesia (Fig. 163)
- 4 Regional Anesthesia
- 5 Spinal Anesthesia
- 6 Intravenous Anesthesia.

General Considerations. The type of anesthesia to be employed in a given case depends to a large extent upon the age of the patient, the general condition, the region to be operated upon, and whether it be a major or minor procedure. Thus, local anesthesia can rarely be employed in children below the age of 12 because the patient will not as a rule co-operate. In elderly men with cardiovascular disease, renal disturbances, and emphysema, general anesthesia must be employed with considerable caution because of possible damage to the kidneys and the danger of pulmonary congestion.

Infiltration anesthesia is not very effective in inflamed surfaces. In block anesthesia a successful result is often dependent on the experience of the operator. Caudal anesthesia is not effective in a small number of cases. In infants anesthesia for minor operations such as circumcision is unnecessary and for

¹We are indebted to a paper by J. S. Lundy, "Recent Advances in Anesthesia," Jour. Amer. Med. Assn., Feb. 5, 1933, in the preparation of this chapter.
We are indebted to Dr. Alfred E. Jones for valuable assistance in the preparation of this chapter.

patients who are stuporous or toxic, as in urosepsis or urinary extravasation, a good deal can be done with little or practically no anesthesia

Local and general anesthesia can be often combined for the benefit of the patient. In suprapubic prostatectomy, local infiltration anesthesia for the abdominal wall can be used in conjunction with caudal anesthesia, then a little inhalation anesthesia can be given for a few minutes at the time of removal of the prostate. Thus, various forms of local anesthesia can be combined with general anesthesia in some cases.

One form of anesthetic agent may be used as for induction anesthesia, and followed by a general anesthetic. Thus, avertin can be given by rectum, particularly in children, and may replace preliminary medication. Intravenous anesthesia may also be used as an induction anesthesia to be followed by inhalation anesthesia.

Preliminary medication is essential in most cases. Barbiturates and morphine are the most satisfactory. They reduce metabolism, and when given in moderate doses are more satisfactory and safer than when large doses are administered. Some medication should be given the night before, and another dose combined with atropine should be given immediately pre-operatively. With proper preliminary medication most of the apprehensive patients come to the operating room in a calm frame of mind.

The use of a Magill intratracheal tube for inhalation anesthesia has been recommended when wide respiratory movements interfere with the operation, or where the position of the patient for operation makes breathing difficult. With the use of the tube respirations are much more quiet. The intratracheal tube is also extremely valuable in resuscitation, or when there is danger of asphyxia. The use of oxygen and rebreathing with carbon dioxide at the end of an operation helps to revive the patient more quickly. If the condition of the patient becomes unsatisfactory during an operation caffeine and adrenalin may be given to carry the patient through.

1 GENERAL INHALATION ANESTHESIA

Ethylene appears to be the safest and most satisfactory anesthetic for inhalation. It is now widely used in genito-urinary operations of all kinds, especially in the aged and in other poor operative risks. Anesthesia develops in a few minutes, blood pressure is very little altered, there are practically no after-effects, and the patient is conscious within a few minutes after the operation. However, when deep anesthesia is required, ether must be added. Ethylene, as well as ether, is inflammable and explosive, and neither can be used where electrosurgery is being done. Cyclopropane, which was introduced by Waters, is rapidly coming into general use, and is replacing ethylene in some clinics. The anesthesia is deeper and more satisfactory than with ethylene and no ether is necessary for deep anesthesia. Ether is still a satisfactory and safe anesthetic. The open mask drip method is still employed in many clinics. Ether alone is safer than nitrous oxide, for the latter elevates the blood pressure. Nitrous oxide interferes with oxygenation, it does not give deep anesthesia, and is not entirely safe in the aged. However, nitrous oxide is still widely used, chiefly, however, for anesthesia of short duration. It is frequently employed for induction anesthesia to be followed

by ether Nitrous oxide is not inflammable, and can be used where ether and ethylene are contra indicated.

2 SURFACE (MUCOUS MEMBRANE) ANESTHESIA

Topical application to the posterior urethra preliminary to instrumentation is not as often used at present as formerly. A special tube (Fig 162) can be used to deposit Alypin tablets in the posterior urethra. Instillation of a few cc. of a 1 per cent Metycaine solution through a Guyon catheter gives good anesthesia in the posterior urethra. Metycaine is a more satisfactory surface anesthetic than Novocaine and its action is more prolonged. Injection of a 4 per cent Novocaine solution into the urethra is also of value preliminary to instrumentation. Ten per cent Novocaine can also be employed but it is well to remember that reactions may occur. Cocaine has been discarded as a local anesthetic in urology.

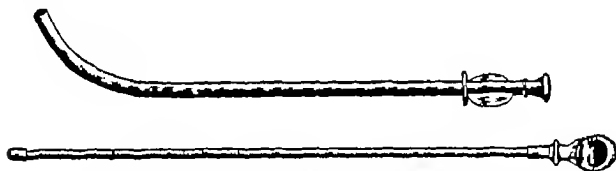


FIG. 162—Bransford Lewis tablet depositor for anesthesia of posterior urethra.

The posterior urethra is very vascular and absorption takes place very readily so that in individuals with an idiosyncrasy to cocaine or to high concentrations of Novocaine may result in severe reactions. We have had this experience in a number of instances. When such Novocaine reactions occur either with caudal anesthesia or following instillation in the urethra sodium amytal given intravenously will stop the convulsions and counteract the effects of the Novocaine.

In infiltrations and strictures of the urethra with a mucous membrane which is not intact, absorption is very rapid. Instillation of an anesthetic into the bladder is of little value and is seldom employed. The bladder is not sensitive and fulguration of small papillomata can be carried out successfully if the urethra has been well anesthetized. In cases of very narrow strictures as well as in chronic cystitis particularly tuberculous and interstitial cystitis, it is often advisable to use caudal anesthesia preliminary to dilatation of the urethra or before cystoscopy.

3 INFILTRATION ANESTHESIA AND NERVE BLOCKING

These two forms of local anesthesia have a wide application in urologic surgery. They can be used over any area and can be combined satisfactorily with other methods of anesthesia.

(a) In infiltration anesthesia (Fig 163) the fluid is injected along the line of incision. This is also often combined with field block (Fig 164) as is usually done in supra pubic cystotomy. A 1 per cent Novocaine solution is the best anesthetic to use. For inflamed surfaces, ethyl chloride spray can be used because infiltration anesthesia is not as effective here. However as a general rule infiltration anesthesia is quite satisfactory even in inflamed surfaces.

We have done a large number of operations on the kidney under local infiltration anesthesia. Perinephritic abscess can be opened and drained through a small muscle-splitting lumbar exposure under local infiltration anesthesia. We have also done a large number of nephrostomies through a muscle splitting lumbar exposure of the lower pole of the kidney under local infiltration anesthesia.

(b) Block anesthesia or field block is of particular value in operations on the external genitalia in the male. Practically all scrotal operations can be done with a circular block high up on the scrotum together with infiltration of the cord. For circumcision a circular ring of anesthesia in the middle of the shaft of the penis, together with infiltration of the corpora cavernosa is satisfactory. Suprapubic cystotomy is also done under field block. Cystotomy is a minor procedure and wherever possible should be done under local anesthesia. There is no need, in most cases, for inhalation or spinal anesthesia. Local anesthesia

FIG 163

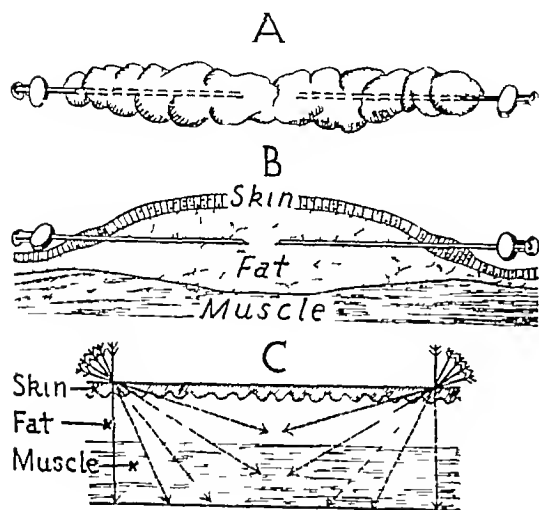


FIG 164

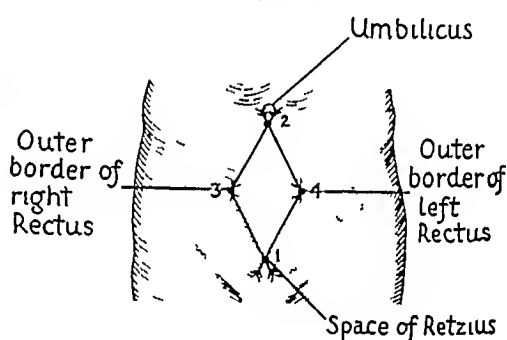


FIG 163—Diagrams of various forms of local anesthesia
 A Intradermal, usually employed in line of incision
 B Subcutaneous, for use in blocking nerves supplying skin and fatty tissue
 C Deeper blocking of nerves of muscle and periosteum

FIG 164—Area of field block for suprapubic cystotomy. The numbers indicate points at which needles are inserted into subcutaneous layer and fluid injected in direction of arrows

routinely employed for cystotomy has given a definite reduction in the mortality from this operation in old men.

FIELD BLOCK FOR SUPRAPUBIC CYSTOTOMY Wheals are raised at the four angles of a rhomboidal area whose outer angles correspond to the lateral edges of the recti, the upper, to the umbilicus and the lower, to the pubes (Fig 164). From these points, the subcutaneous tissues are first injected in a radiating manner, then the muscular structures along the line of incision, and finally the needle is inserted into the prevesical space. It is usually only necessary to use a 0.5 per cent Novocaine solution.

Anesthesia of Penis and Scrotum (Figs 165 and 166) In this area, we prefer to use the regional or nerve block method. A one per cent solution of Novocaine either with or without suprarenin, is the drug of choice. For the scrotum and its contents, points selected for the initial wheals are No. 1 and No. 2, on each side (Fig 166) where the scrotal skin joins with the skin of the thigh. In bilateral operations, all these points are connected by a circular subcutaneous injection and in addition, ten cubic centimeters of the solution is injected directly into the cord at points 1 and 2. Not more than 50 cc. of the solution is used for bilateral opera-

tions This procedure is especially applicable to operations such as hydrocele or varicocele when a scrotal incision is used.

For all operations upon the penis, from complete amputation to circumcision, no better method has been devised than the circular injection of the skin of the penis at its base This is preferred to local infiltration in circumcision for two reasons It does not distort the field of operation and it does not carry infected material into the deeper tissues from a foreskin which is frequently inflamed This is especially desirable in the dorsal slit operation for balanitis The points of entrance of the needle are directly over the pubic bone where the spermatic cord crosses. With the penis drawn out a subcutaneous circular injection is made From

FIG 165

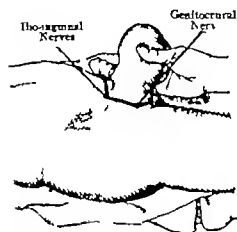


FIG 166



FIG 165—Blocking of the scrotum (after Braun) Wheals are made as in Fig. 163 over the pubic spines to inject the ilio-inguinal nerves and two others (one on each side) a little lower to inject the genito-crural nerves. The spermatic cord and pubes are injected through the wheals over the pubic bone and subcutaneous injections are finally made passing around the base of the penis and joining all the wheals together

FIG. 166—Field block for operation on the penis (after Braun) wheals are raised just middle to and below both pubic spines. The heavy lines indicate the subcutaneous infiltration around the base of the penis.

below the needle penetrates the scrotum and above it reaches to the suspensory ligament of the penis Usually fifty cubic centimeters of the solution will suffice, but in fat persons frequently 75 cc. will be required. This procedure is especially applicable in plastic operations on the penis such as in hypospadias and closure of a fistula in the penile portion of the urethra.

4 REGIONAL ANESTHESIA

Field block anesthesia may be included under this heading but when regional anesthesia is discussed some form of nerve block is usually considered Regional anesthesia differs from local anesthesia in that the fluid is not injected along the line of incision In nerve block extra or para neural injections near the nerves cut off the conductivity of the nerve Caudal extradural or sacral anesthesia is commonly used at the present time Parasacral and paravertebral anesthesia are seldom employed. Parasacral anesthesia is difficult It involves injection of the sacral foramina and is superfluous for caudal anesthesia suffices in the majority of cases.

Paravertebral anesthesia has a rather limited use It has been used extensively by Ilves in renal surgery but is rarely employed in this country In this procedure

the lower 4 thoracic nerves are blocked through the liberal use of large quantities of anesthetic

Technic of Sacral or Caudal or Epidural Anesthesia Some prefer to place the patient on the side, others in a prone position with a folded pillow or sandbag under the pubes. One can locate the sacral notch in three ways (a) by passing the index finger downwards (caudally) along the spines of the sacrum,

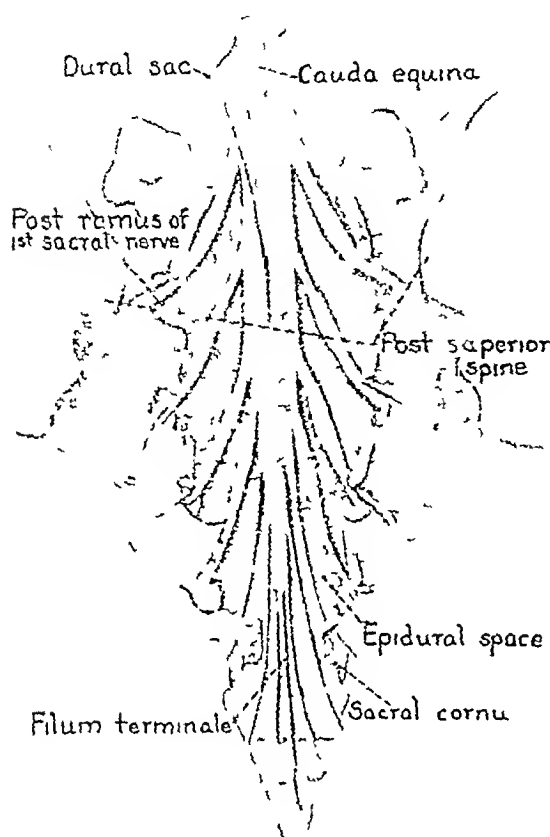


FIG 167—Posterior wall of sacral canal removed so as to show point of termination of the dural sac, also epidural space and relation of sacral and coccygeal nerves to the respective foramina of exit (After Labat Meeker and Bonar)

(b) by beginning at the coccyx and passing the finger upwards, (c) by palpating the sacral cornua (Fig 167) between which the notch lies. After having felt the depression (Fig 168) corresponding to the sacral notch, an intradermal wheal (Fig 163) is made over it with the anesthetic solution and the shortest needle. A longer (8 cm) needle is now inserted at an angle of 30 to 40 degrees (Fig 169), down to the fibrous covering of the notch. This ligament is penetrated until one meets with the resistance of the anterior wall of the sacral canal (Fig 169). The needle is now withdrawn slightly and its distal end watched to see if clear fluid or blood escapes. The presence of the former means that the dural sac (Figs 167 and 169) has been punctured. If so, the needle must be entirely withdrawn and reintroduced. The same is true if blood escapes, as this indicates a penetration of some vein. If one encounters much resistance in injecting the anesthetic solution, it means that the tip of the needle has been

misplaced and lies either in the subcutaneous fat or in the periosteum. As soon as the membrane or ligament which fills the sacral notch has been penetrated, one depresses the needle 20 degrees. The needle must never be inserted more than 3 to 4 cm and one must inject very slowly (for at least two minutes) using 30 cc of the solution (see above).

We have had only a limited experience with peridural anesthesia. It may be safe in the hands of those who have mastered the technique, but its application will be limited because of the danger of injury to the spinal cord. It can be employed as a substitute for spinal anesthesia, from 30 to 50 cc of a 2 per cent Procaine adrenalin solution are injected.

5 SPINAL ANESTHESIA

This form of anesthesia has a large place in urologic surgery. All operations on the bladder, prostate and perineum can be safely and satisfactorily done under

spinal anesthesia. The structures are markedly relaxed the operation can be done expeditiously with a minimum of hemorrhage, and with no general reaction, if the operation and height of anesthesia are limited to the pelvis

Spinal anesthetics administered in moderate doses are very useful. The danger in spinal anesthesia lies in the degree of paralysis and the height to which the anesthesia and paralysis rises. In order to keep within safe bounds a limited dosage should be administered. We question the advisability of using more than 150 mg. of Novocaine crystals for anesthesia. Many urologists do kidney surgery under spinal anesthesia but the majority feel that it is a very good and safe anes-



FIG. 168.—Photograph of sacrum, coccyx and a portion of the ilium. X indicates posterior superior spine of ilium. (See text.)

thetic for lower urinary tract operations only and should be employed for kidney surgery only when particularly indicated. Spinal anesthesia should also not be given for prolonged operations. It is much better to give a small dose and if the operation is prolonged to supplement it with general anesthesia. In this manner the various complications of spinal anesthesia may be averted.

Various anesthetics have been used—Spinocaine, a combination of Novocaine and Strychnine is a very satisfactory preparation. It is of a lower specific gravity than spinal fluid so that the patient must be immediately placed in Trendelenburg position.

Novocaine, preferably in the form of crystals which are dissolved in the spinal fluid, is the safest preparation for spinal anesthesia. The solution is injected through a lumbar puncture. 50 to 100 mg. suffices for all perineal and transurethral operations and 100 to 150 mg. for bladder surgery. Ephedrine is always administered in conjunction with spinal anesthesia in order to prevent any marked lowering of blood pressure.

When the anesthetic is given in large doses respiratory paralysis has occasionally resulted with immediate death. Paralysis of the diaphragm if the anes-

thetia is high, will interfere with aeration of the lungs, and thus the incidence of pneumonia may be greater here than with inhalation anesthesia. When the patient is debilitated, or the concentration of hemoglobin is less than 50 per cent, spinal anesthesia should not be administered. Systolic blood pressure of 200 and over is a contraindication to spinal anesthesia, as is also a low pressure of 100 or less.

6 INTRAVENOUS ANESTHESIA

Sodium amytal was one of the first anesthetics that was employed intravenously. The length and depth of anesthesia were difficult to control and deter-

FIG 169

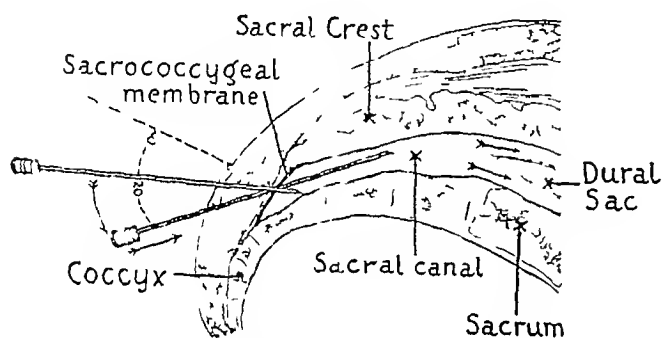


FIG 170

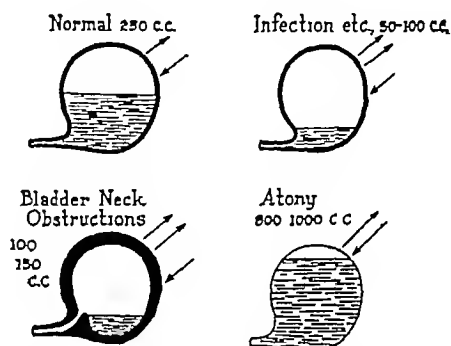


FIG 169—Diagrammatic representation of manner of introduction of needle for caudal anesthesia. Note how sacral notch is covered by sacrococcygeal membrane which must be punctured by needle. Note angle at which needle is first introduced, i.e., until it encounters anterior bony wall of sacral canal. The needle is then withdrawn and its outer end depressed about 20 degrees to enter canal. The arrows indicate how fluid infiltrates upwards around outside of dural sac (After Braun and Labat).

FIG 170—Diagrams to illustrate causes of frequency. Desire to urinate felt when normal bladder holds 250 to 300 cc. This desire experienced in cystitis and in cases of bladder neck obstructions when amount in bladder much less. In atony no desire is felt until large amount in bladder.

mine, and it has been replaced by Evipal and Pentothal. These drugs are used only for short anesthesia, and particularly for minor procedures, and can also be used as induction anesthesia preliminary to general anesthesia. Anesthesia is quickly induced, and the patient wakes up rapidly with no untoward reactions. Cystoscopy and other transurethral manipulations can be done with intravenous anesthesia, also the removal of a packing which is often a very painful procedure otherwise.

CHAPTER 10

TERMINOLOGY AND UROLOGIC STUDY

TERMINOLOGY AND UROLOGIC STUDY

DISTURBANCE-OF URINATION TERMS

CHANGES IN URINARY OUTPUT AND COMPOSITION OF URINE

MISCELLANEOUS TERMS

TAKING A UROLOGIC HISTORY

LOCAL UROLOGIC STUDY (OR EXAMINATION)

CHIEF CLINICAL DATA

By the urologic study of a patient is meant the taking of the clinical history followed by the general physical examination and the application of the various diagnostic methods which have been described in preceding chapters

A knowledge of the technical terms employed in urology is essential in the taking of the clinical history. An easy way to remember the terms is to place them in three groups, as follows

- 1 Terms indicating disturbances in urination
- 2 Terms indicating changes in the output and in the constituents of the urine
- 3 Miscellaneous terms

1 DISTURBANCE-OF URINATION TERMS

By frequency (Fig 170) is meant an increase in the number of times the patient voids above what is considered the normal which is 4-5 times during the day and not at all during the night. Nocturia is the term applied to nocturnal frequency but the only one used to express frequency during the day is diurnal frequency

Dysuria really means etymologically difficulty in voiding but it is used by some to signify painful urination. We prefer the former definition. When a patient feels that he cannot wait to void we speak of urgency and when this is preceded or followed by severe cramp-like pain due to spasmodic contraction of the vesical sphincter the term tenesmus is employed. As soon as the bladder has been emptied the sensation of wanting to urinate recurs and the same cycle is repeated.

Retention. When the bladder is full and the patient is unable to void we speak of retention which may be acute or chronic according to the mode of onset and clinical course. If the bladder overflows in cases of retention the terms incontinence of retention, paradoxical retention or false incontinence are used. If the patient with chronic retention voids and is then catheterized the amount of urine found in the bladder is termed the residual.

Enuresis is the special term applied to incontinence in children which may be nocturnal or diurnal. The simple term incontinence is used to designate loss of control of the ability to empty the bladder of all types, but it is also employed for the constant dribbling (escape in minute amounts) of urine as seen in cases of ectopic ureteral openings.

2 CHANGES IN URINARY OUTPUT AND COMPOSITION OF URINE

The normal adult voids 1500 cc. in 24 hours. In certain diseases this rises to 5-6000 cc. and the term polyuria is employed as indicating such an increased output. If for example the 24 hour urinary output drops to 250-300 cc. the term

oliguria is used, whereas if repeated catheterization reveals an absence of any urinary output, the term anuria is applied. Any marked decrease in urinary output without sufficient intake of fluids, is followed by a condition termed dehydration, characterized clinically by thirst, dry tongue and skin.

In all urologic cases, the 24-hour intake and output of fluids needs constant watching and should be noted on the chart.

Terms used to describe changes in the constituents of the urine are

(a) Hematuria indicates the presence of red blood cells in the spontaneously voided or catheterized urine. The term gross hematuria means the presence of enough blood to be seen with the naked eye. If it is only found on microscopic examination, the term microscopic hematuria is used.

(b) Pyuria means the presence of more than 5-7 leukocytes to the high power field in the catheterized uncentrifugated specimen. We will take this up again in the Chapter on Variations in the output and composition of the urine.

(c) Bacteriuria is the term used to indicate the presence of bacteria in the urine without a concomitant pyuria. If the bacteria are of the *B. coli* group or tubercle bacilli, the term bacilluria is often employed.

The meaning of the terms phosphaturia, oxaluria, chyluria, pneumaturia is self-evident. They will also be taken up later in the Chapter on Variations in the output and composition of the urine.

3 MISCELLANEOUS TERMS

This group includes such terms as

(a) Urosepsis—to indicate a bacteremia, verifiable by blood cultures, which has its origin in the urinary tract, usually in one or both kidneys.

(b) Terms ending in "cele" like hematocele, hydrocele, spermatocele and ureterocele indicating retention or collection of fluid in preformed cavities.

(c) Terms ending in "rhea" to indicate discharge or "flow" from certain epithelial lined structures, as gonorrhea, spermatorrhea, prostaticorrhea, etc.

The terms pyelolithotomy and ureterolithotomy are now being more commonly employed instead of pyelotomy for calculus or ureterotomy for calculus. Also it is more convenient to speak of ureterectasis, pyelectasis and caliectasis instead of dilatation of these respective structures.

TAKING A UROLOGIC HISTORY

The age, sex, place where born, occupation, how long in the country, etc., are all noted. At first glance, questions as to these may appear of little importance. We will see later that some urologic conditions, such as prostatic enlargement, vesical diverticula and tumors, are more likely to occur at certain ages. Again a lead worker may be subject to colic simulating to a certain extent, those of upper urinary tract lesions. Aniline workers not infrequently present symptoms such as hematuria, or bladder tumors. (See Chap. 27.) The place where an individual has been born or lived is of importance at times, since certain tropical parasitic diseases such as bilharziasis, localize in the bladder. It is endemic in Egypt but cases have been reported as having been found in the United States. The routine

method of taking the history after the above data have been noted is to ask the following questions in the order named

- 1 Chief complaint.
- 2 Onset and course of the present condition
- 3 Symptoms referable to other parts of the body
- 4 Previous illnesses operations etc.
- 5 Habits.
- 6 Venereal history
- 7 Sexual history
- 8 Family history
- 9 General and local (urologic) examination Let us consider these a little more in detail

1 Chief Complaint. This should be asked immediately after the data regarding age occupation birthplace, etc. have been secured. The patient is asked to state why he or she has come for medical aid i.e. what is the outstanding symptom and how long has it been noticed If there are other complaints which accompany the main one, they must also be enumerated and the time they have existed, noted For example

Chief complaint

- (a) Frequency of urination—two weeks duration
- (b) Burning on urination—same period
- (c) Noticed blood at end of urination also for same period

2 Mode of Onset and Course. Under this heading in the history the details of each complaint must be obtained not only as to the time when but also how they began. The patient should be permitted to give his or her version without any prompting by the one who is taking the history In other words the examiner should never "lead" the patient asking for example Did you notice this or that? Some patients will think it helpful to answer in the affirmative to every question until the examiner is confused as to the real nature of the mode of onset, its chief and accompanying symptoms The two last named must be accurately recorded as to when they were first observed and how they appeared, etc., as the chief and accompanying complaints.

This is the subjective portion of the history It represents the patient's own version of his or her case We can only repeat that they must be encouraged to give every important detail without being "led" by the one taking the history into certain channels which would seem to fit in with a tentative diagnosis.

In the case of an acute urethral discharge in the male or of a similar vaginal discharge in the female or of an acute epididymitis etc. it is self-evident that such an elaborate history is superfluous One only needs to know the period since exposure occurred whether the present attack is the primary one, whether and how it has been treated, etc.

In other cases, every effort should be made to ascertain not only the mode of onset and course of the chief and accompanying complaints but also whether the present illness is the first of its kind, if similar attacks have occurred, how long they have lasted, the intervals between them, etc.

In taking the history of a urological case, the symptoms referable to the genito-urinary tract are of course first considered in developing the history of the chief and accompanying complaints. An indispensable portion of our task however is

to ascertain whether any symptoms referable to other structures of the body have been present since the onset of the illness for which advice is being sought. This is done under the next heading.

3 Inventory by systems¹ (or general and negative) Here every portion of the body is included in questions put in such a way as again not to "lead" the patient. Much tact is required to do this because some individuals feel that they will not receive what they consider is the necessary amount of attention, unless they answer affirmatively every question under this heading. One begins with the head and neck, continues with the heart, lungs, gastrointestinal tract, symptoms referable to the nervous system and extremities of the individual. These may or may not seem to have any bearing on the complaints for which the urologist has been consulted. The patient may have been referred for examination by some other specialist to ascertain whether conditions in the urinary tract are responsible



FIG 171—Roentgenograms from case of rarefying type of diffuse carcinomatosis of pelvic bones and spine secondary to carcinoma of prostate

A Note honey-combed appearance of bodies of vertebra (best seen with magnifying lens)

B Same condition (osteoporosis) of the pelvic bones especially in pubic and ischial rami

for abdominal pain, frequency, retention, hematuria and similar symptoms. All of these may equally as well be due to conditions outside of the province of the urologist. If the latter is the first one to be consulted, he on the other hand, may desire the opinion of others as to the importance of shortness of breath, cough, hemoptysis, etc. of which the patient also complains.

We shall see shortly that complaint of pain in the back or in the extremities in a suspected prostatic cancer case should always lead to a radiographic examination² (Fig 171) of at least the spine, pelvis and bones of the lower extremities for metastases. Along the same line may be mentioned the necessity of a stereoscopic picture, or of fluoroscopy of the chest if the patient complains of dyspnea or cough accompanying a tumor of the kidney or testis, or following its removal (Fig 172).

We have encountered several cases erroneously diagnosed as pulmonary tuberculosis which were metastases of a previously operated tumor of the testis. In the case shown in Fig 171 the chief complaint in a man seventy years of age, was pain in the back radiating downwards along the posterior aspect of both legs. The

¹ This term has been employed for many years by us and seems a fitting one

² If possible, this should be done routinely in every case of prostatic carcinoma

frequency of urination was of secondary importance in his opinion, yet rectal examination revealed a carcinoma of the prostate and subsequent radiography, a very widespread metastatic involvement of the vertebrae ribs and pelvic bones

4 History of Previous Illnesses Operations, etc This should include a brief résumé of the following

(a) THE DISEASES OF INFANCY, with special emphasis on any infectious diseases such as scarlatina which might have been complicated by a nephritis

(b) ANY ILLNESS SINCE CHILDHOOD such as pneumonia typhoid, rheumatism tonsillitis, dental history, diabetes, etc

(c) FORMER OPERATIONS OR INJURIES their character and possible bearing on present illness.



FIG. 172—Roentgenogram of chest one year after removal of testis for malignant neoplasm. Note multiple scattered shadows due to metastases in both lungs.

(d) SIMILAR SYMPTOMS OR ATTACKS to one now complained of and if seen by physician what was done

(e) LOSS IN WEIGHT how much and over how long a period

(f) OBSTETRICAL HISTORY as to number of births also whether complications and any miscarriages.

(g) MENSTRUAL HISTORY

5 Habits as to Alcohol, Tobacco Coffee, Tea, Drugs, Sexual Life, also details as to how occupation or diet might influence present illness

6 Venereal History⁴ Previous attacks of urethritis treatments complications and sequelae Character of any ulcerative process on external genitalia. Its duration whether any secondary or tertiary manifestations, treatments, etc.

7 Sexual History

8. Family History Ascertain cause of death of immediate relatives with special reference to tuberculosis, cancer psychopathic conditions etc.

Allergy as a cause of frequency is taken up later

We wish to express appreciation of the excellent history blank for urologic cases devised by D. H. A. Rosenkranz of Los Angeles.

9 General and Local Examination The former includes the blood pressure, pulse rate, also its character, respiration, temperature (we prefer rectal temperatures in all acute conditions), weight, skin, state of nutrition, etc. These data having been recorded, we next proceed to an examination of the (a) head and neck (with report on condition of teeth and tonsils by consultants if deemed necessary) This is the routine in some clinics (b) Heart In prostatics the value of electrocardiography cannot be emphasized too much (c) Lungs, (d) nervous system It is of special importance to examine for evidence of tabes and other spinal cord lesions, such as immobile pupils, ataxia, loss of or diminished reflexes, etc (e) Examination of spine, pelvis and extremities, for arthritis and for possible metastases (Fig 171), etc (f) Blood, including hemoglobin, red and white cell count, blood chemistry with reference to nonprotein nitrogen (urea), as explained in Chapter 8, Wassermann test, and finally coagulation time We will include the examination of the abdomen under the next heading, viz, local urologic study

LOCAL UROLOGIC STUDY (OR EXAMINATION)

The method of examination of cases of acute, subacute and chronic urethritis and their complications, is so thoroughly covered in the following chapters that it is inadvisable to repeat it We shall therefore limit the description here to an outline of the order in which the examination of the genito-urinary tract is made in our clinic Comments which seem of importance will be added in connection with each heading

CHIEF CLINICAL DATA

Here the outstanding features of the history as well as findings in other portions are briefly noted

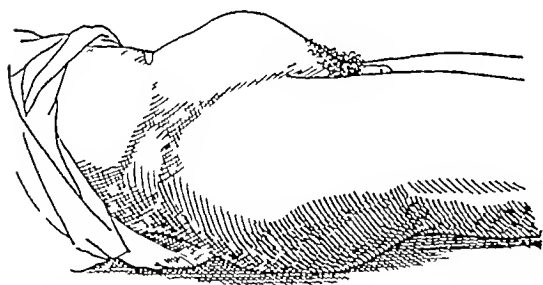


FIG 173—Side view of greatly distended bladder Note prominence over suprapubic region (Papin)

1 Abdominal Examination

Note any prominence especially over the lateral portions of the abdomen Do not forget that a greatly distended bladder may give rise to a visible prominence (Fig 173) in the suprapubic region At times, as in a recent case, one could see such a median enlargement, and extending from its left wall, another slightly smaller one The former was due to urinary retention in the bladder and the lateral

tumor to a very large and greatly distended diverticulum of the bladder We were nearly led astray by this lateral enlargement, our first impression being that some form of neoplasm had its origin in the perivesical tissues

2 Palpation This should include examination for painful areas, evidences of muscular rigidity, as well as the usual characters of any visible or palpable enlargement, such as its location, size, borders, surface, consistency, fixation, etc (as taken up in the Chapter on kidney tumors) One must always bear the following in mind, in an examination by inspection and palpation

The enlargement, etc may be in a normally developed and located viscus

The enlargement etc. may be in a viscus which is located abnormally as the result of ptosis or development of the thorax and abdomen in general

The enlargement, etc. may be in a kidney which is the seat of an anomalous development location etc.

Occasionally a ureteral anomaly may present an abdominal enlargement or other symptom which would be difficult to understand unless the possible occurrence of such anomalies was borne in mind.

In connection with unusual localization of abdominal enlargements pain, etc. always remember that the kidney may occasionally be located in the midline (Fig

FIG. 174

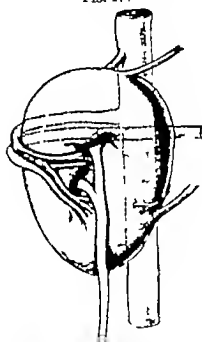


FIG. 175

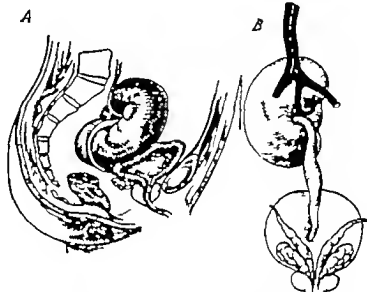


FIG. 174—Case in which a congenital ectopic kidney was found to lie directly over aorta. (Lejars and Rubens-Duval)

FIG. 175—Two views of case of ectopia of a congenital solitary kidney (Schultz)

A. Kidney lies in true pelvis between bladder and rectum its pelvis faces dorsally
B. View from behind showing relation of kidney to bifurcation of aorta and also ending of the ureter in midline of bladder

174) of the body and be of the congenital solitary variety i.e. the only one the individual has. Again the kidney may be in the true pelvis an anomaly termed pelvic ectopia (Fig 175) and also this may be a congenital solitary one. Again the two kidneys may be fused and lie entirely on one side of the body or extend across the median line forming an L-shaped structure part of which may extend into the true pelvis (Fig 176)

The two most frequently employed methods of palpation of the kidney are either with the patient lying on the back or on the side.

3 Examination of External Genitalia. This should include search for anomalies of the penis and urethra as described later. If incontinence of urine is complained of never fail in females to search for the ectopic opening of a ureter in the vagina or vestibule. It may be just below the external meatus (Fig 177). Inspect and palpate not only the penis and urethra, but also the contents of the scrotum. One records the location of the testis i.e., whether in the scrotum or not,

the size, consistency etc , of the testis, epididymis and vas If there are no positive findings, we simply place in the record "nothing abnormal" rather than "negative"

4 Rectal Examination This is of especial importance in the male and yields information (Figs 108, 109, 110) as to the size, consistency, fixation, etc, of the prostate, also as to similar conditions of the seminal vesicles and of the area

FIG 176

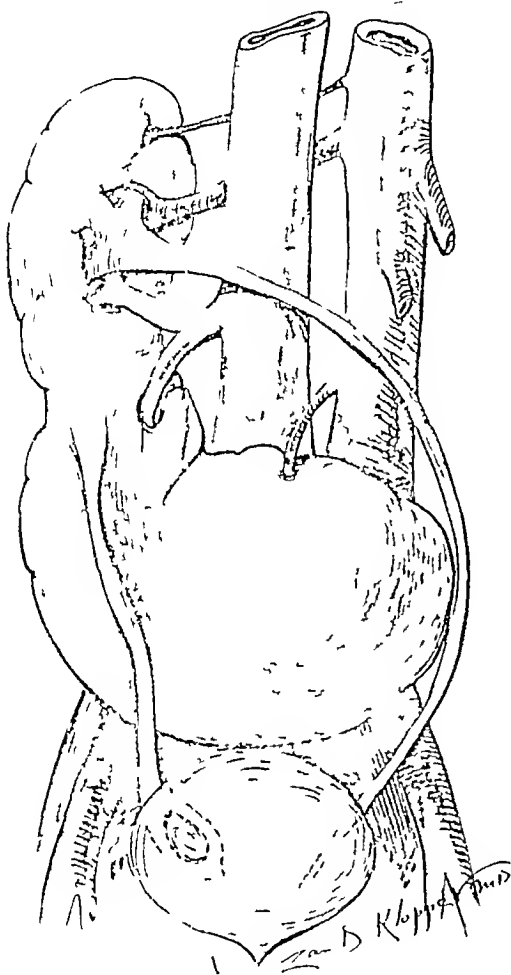


FIG 177

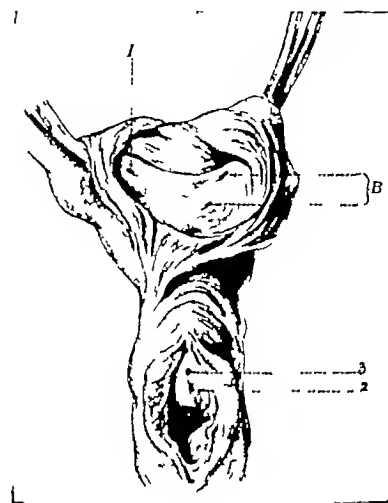


FIG 178

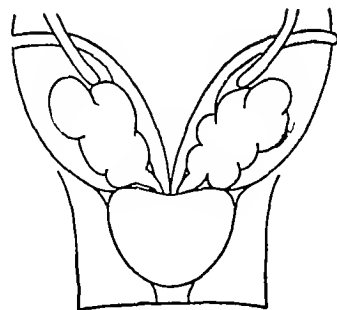


FIG 176—L-shaped kidney with hydronephrosis of lower half due to faulty origin of ureter and blocking of latter at its vesical end by a calculus (From a German thesis)

FIG 177—Ectopic ending of one of the ureters of a double kidney just below external meatus in girl of 15 (Baetzner)

B Openings into bladder of both ureters of double kidney on opposite side

2 Ectopic ureteral orifice

3 External meatus

Opening of ureter of other half at normal location

FIG 178—Diagram employed by Dr Hugh H Young to record findings on rectal examination of prostate and seminal vesicles

between them (the intervesicular space) An excellent diagram (Fig 178) is employed by Dr Hugh H Young for recording the results of the rectal examination

5 Urethra (including urethroscopy) Under this heading are included (a) the various tests outlined in the next chapters, for cases of urethritis and complications of this condition, and (b) urethroscopy An examination of the urethra with

the aid of bulbous bougies etc., as described in Chapter 6 should always precede urethroscopy. Many urologists fail to do this routinely and find that further examinations are impossible because the deep urethra is so narrow as to prohibit the introduction of even the smaller caliber urethrosopes or cystoscopes. Inspection of the posterior urethra with some type^s of instrument in which continuous irrigation is employed should always precede or be combined with an inspection of the bladder.

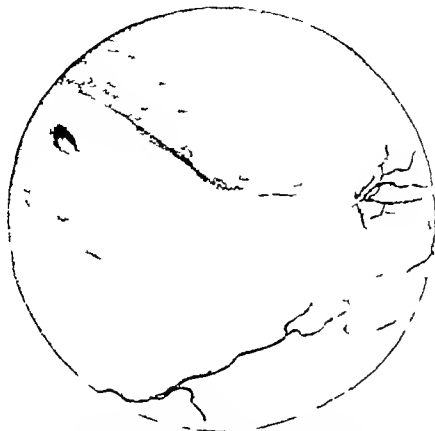


FIG. 179—Absence of left ureteral orifice and asymmetric development of trigone in a case of congenital (right) solitary kidney (Baetzer)

6. Cystoscopy The technic etc., have been described in Chapter 6. We only wish to direct attention to the importance of including in the record data as to the following:

- (a) The caliber of the instrument passed
- (b) The tolerance^s of the bladder and character of its contents
- (c) The amount of residual urine
- (d) The appearance of the bladder vertex and walls.
- (e) Details in regard to the trigone and any intravesical protrusion
- (f) The internal urethral orifice

7. Inspection of Ureters and Ureteral Catheterization. We emphasize the recording of the following:

- (a) THE LOCATION ⁷ APPEARANCE ETC. OF THE URETERAL ORIFICES. One must

See Chapter 6

In renal tuberculosis, a satisfactory examination is impossible without caudal anesthesia.

The use of indigo-carmin is warmly recommended as an aid in locating the ureteral orifices in difficult cases.

never forget that there may be only one orifice in cases of congenital solitary kidney (Fig 179) and even if there are two, that this does not indicate completely developed ureters and kidneys on both sides (Fig 180)

(b) **THE CHARACTER OF THE EFFLUX** (urine expelled after each ureteric peristaltic wave), from the ureteral orifice. It may be clear, turbid, bloody or escape as a thick creamy paste (pyonephrosis). At the same time one can record how the vesical orifice of the ureter acts during its opening and closing

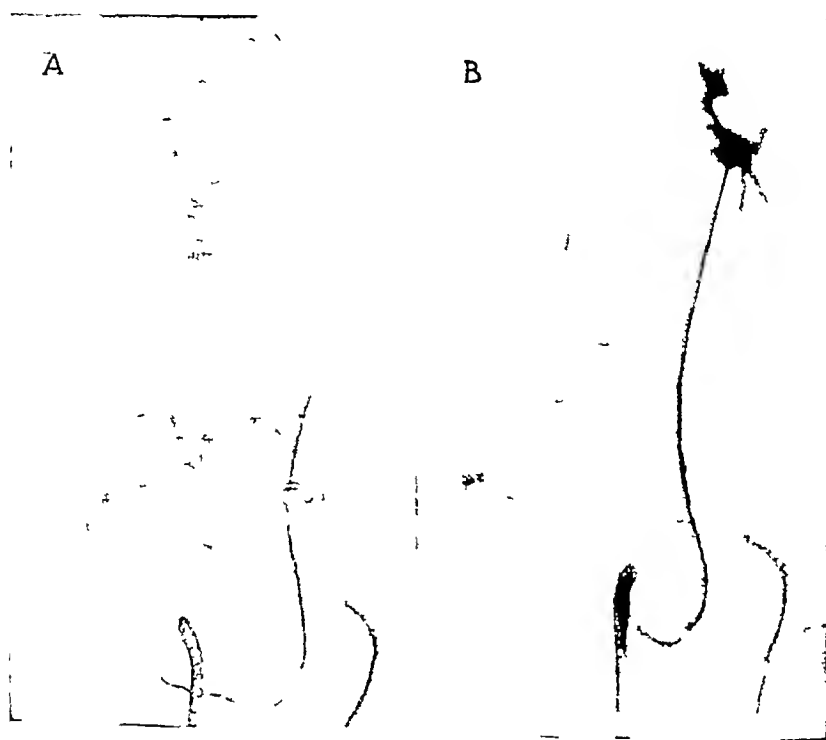


FIG 180—Radiographic findings in case of congenital solitary kidney with a rudimentary ureter on aplasia side

A On the right side, the opaque catheter could be inserted for a distance of 4 cm into the ureter. Kidney and remainder of ureter were found absent on this side. Ureteral orifice, however, appeared normal in every respect.

B Opaque catheter on solitary kidney side (left) extends to renal pelvis. Pyelogram reveals faulty rotation of kidney, its pelvis facing ventrally.

(c) **OBSTRUCTION MET IN CATHETERIZING THE URETERS** Record the size and type catheter or bougie employed, the level at which the obstruction was encountered and also the results of passage of the obstruction. A calculus at the uretero-pelvic junction or elsewhere in the ureter, may block the passage of a catheter at one examination and present no resistance at another, when it has either floated back into another portion of the renal pelvis or has migrated to another level of the ureter.

(d) **RESULTS OF FUNCTIONAL TESTS** These are taken up in Chapter 8. The results of this portion of the urologic study should be recorded in connection with the other data secured by ureteral catheterization.

(e) **SMEARS AND CULTURES** Under this heading are placed the findings after stains of the centrifuged sediment of the two separate urines have been made, the results of culture studies as well as those of animal (guinea pig, etc.) inoculation.

(f) **EXAMINATION OF URINE** (including a record of the amount from each

side) This includes chemical and microscopical examination of the centrifuged separate urines

(g) RADIOGRAPHY including the use of the opaque media for outlining the urethra, seminal vesicles, bladder, ureter and renal pelvis as outlined in Chapter 7

(h) BLOOD CHEMISTRY The value of the various substances from a prognostic standpoint was discussed in Chapter 8 The results of such an examination are included in our record sheet at this point as a vital portion of the urologic study

We can warmly recommend following such an outline⁸ as a more or less routine procedure in the examination of cases with symptoms referable to the genito-urinary tract The limitations in cases of acute urethritis, cystitis etc. are self-evident

Even in cases of bladder neck obstruction we now include plain radiography of the upper urinary tract to rule out renal or ureteral calculi in every case

ORIENTATION

The rapidly increasing frequency of venereal diseases in this country, as reflected by the U S Public Health Service reports, has made Gonorrhea, Syphilis and other venereal ulceration a national health problem which is being fought with all of the resources at the disposal of the national and state authorities. The necessity of teaching the student (a) to distinguish a specific (gonorrheal) from a non-specific form of urethritis, (b) to be familiar with the gross appearance of a chancre or a chancroid and (c) to know that other types of venereal ulcers and tissue changes, such as lymphopathia venereum exist, cannot be too strongly emphasized.

The gonococcus has a selective action on epithelial and endothelial lined surfaces. Its most common primary localization in the male is on the mucous membrane of the urethra and in the female on the mucous membrane of the vagina and the cervix uteri. The infection extends by continuity along these epithelial lined structures to the posterior urethra, prostate, seminal vesicle and epididymis in the male to the fallopian tubes and peritoneum in the female. The student must try to take a bird's-eye view of gonorrhea and not think of it as a purely local infection. Involvement of the endothelial lined cavities like the heart, pleura, peritoneum and joints, although not common, is always a potential complication. The tendency at present in the treatment of gonorrhea is toward conservatism, at least in this country. The local reaction of the tissues toward the toxin of the gonococcus is much more appreciated now than formerly. The action of such newer drugs as sulfanilamide is in all probability in the direction of aiding this local resistance of the tissues, rather than through any direct bactericidal action. Many local and systemic complications can be avoided in the treatment of gonorrhea by keeping in mind this factor of local tissue reactions to the toxin of the gonococcus.

Just as there has been a demand for those with special training in the diagnosis and treatment of injuries and diseases of the urogenital tract in the male and female, so there has arisen a call for syphilographers. In the chapter on early syphilis, we have limited discussion chiefly to teaching the student to recognize a chancre and to learn to distinguish the primary lesion of syphilis from other venereal ulcers.

The essentials of the course and treatment of the disease are discussed with the inclusions of the recently published outline of treatment of the U S Public Health Service.

The recognition and treatment of syphilis is a daily task for the urologist, so is that of the next most common type of venereal ulcer, i.e., the chancroid, which differs from the other two infections in being a purely local one with some extension to and involvement of the inguinal lymph nodes.

Granuloma inguinale is a noninflammatory disease, chiefly observed in the inguinal region, and most frequently seen in warmer climates. It is generally recognized to be due to a Gram-negative, non-motile, encapsulated bacillus which can be easily stained. The causative agent of lymphopathia venereum is unknown but it is evidently a filtrable virus. The most important diagnostic test for this type of infection is an intradermal reaction discovered by Frei following use of an antigen obtained from the macerated material of a diseased lymph node or the brain tissue of a susceptible animal inoculated with the virus.

CHAPTER 11

GONORRHEA

GENERAL CONSIDERATIONS	EPIDIDYMITIS
ETIOLOGY	PERIURETHRITIS AND PERIURETHRAL ABSCESS
IMMUNITY	EMEMA
REINFECTION AND RECURRENCES	LYMPHANGITIS
EXCITING CAUSE	GONORRHEAL PYELITIS
PATHOLOGY OF GONORRHEA	ESSENTIAL FEATURES OF DIAGNOSIS OF GONORRHEA
PATHOLOGY OF ACUTE URETHRITIS	DIFFERENTIAL DIAGNOSIS OF COMPLICATIONS
PATHOLOGY OF CHRONIC GONORRHEAL URETHRITIS	OF ACUTE GONORRHEA
SYMPTOMS OF ACUTE GONORRHEA	SUBACUTE GONORRHEA
LOCAL SYMPTOMS	CHRONIC GONORRHEA
GENERAL SYMPTOMS	CHRONIC PROSTATOVESICULITIS
1. TYPES OF GONORRHEA	RECURRENCES IN GONORRHEA
HYPERACUTE TYPE OF ACUTE GONORRHEA	CHRONIC ANTERIOR URETHRITIS
SUBACUTE TYPE OF ACUTE GONORRHEA	URINE IN GONORRHEA
SUBACUTE GONORRHEA	PHYSICAL CHARACTERISTICS TESTS
COMPLICATIONS OF ACUTE GONORRHEA	PROGNOSIS OF GONORRHEA
POSTERIOR URETHRITIS	PROPHYLAXIS OF GONORRHEA
PROSTATITIS	SYSTEMIC AND EXTRAGENITAL GONOCOCCAL INFECTION
PROSTATIC ABSCESS DUE TO ACUTE GONORRHEA	TEST
SEMINAL VESICULITIS	SYSTEMIC INFECTION
	EXTRAGENITAL GONORRHEAL INFECTION

GENERAL CONSIDERATIONS

Definition. Gonorrhea is an infectious disease peculiar to man and is usually transmitted through coitus. The etiologic factor is the gonococcus of Neisser. The gonococcus attacks mucous membranes locally and although the organism or its toxin may involve any tissue in systemic infection, it has a predilection for serous and synovial membranes.

The urethral mucosa in the male and the cervical and urethral mucosae in the female are primarily involved in gonorrhea, except in the extragenital infections where the other mucous membranes, the conjunctival and rectal, are primarily infected.

Gonorrhea in the male is an infection of the seminal ducts¹ (Fig. 185), any part or all of which may be involved. Thus the infection may be limited to the anterior urethra in acute gonorrhea, to the prostate and seminal vesicles in chronic gonorrhea. In the vast majority of cases, however, gonorrhea in the male is an entity consisting of infection of the anterior and posterior urethra together with some involvement of the prostate and vesicles. In an appreciable number of cases the entire seminal duct from the anterior urethra to the epididymis (Fig. 185) may become involved.

The infection extends by continuity along the mucosa by way of the lymphatics, and along the lumen and sheaths of the genital ducts, thus making possible the involvement of the entire genital tract and the lower urinary tract in both male and female. Metastatic extension by way of the blood occurs in a small percentage of cases. There is, in practically every case, some degree of systemic reaction to the infection which cannot be considered, however, as systemic infection.

Dangers of Gonorrhea. It has been estimated that gonorrhea attacks between twenty-five and forty per cent of the male adult population. It presents a

¹The term seminal duct is employed to include the mucous membrane from the external meatus to the epididymis.

serum—a Ph 7.6 being best suited. The degree of oxygen tension is also very important. Coagulated human blood serum, serum agar and ascites agar are the favorite media. In cultures, the colonies appear as minute semi-transparent elevated discs. They are discrete, of yellowish-gray color with an opaque center and with regular and uniform margins at first, becoming irregular later.

The gonococcus elaborates a toxin which is an irritant to the urethral mucosa. When absorbed in large quantities, this toxin gives rise to a systemic reaction. The gonococcus when it enters the blood stream, can give rise to a bacteremia.

The particular characteristic of the organ-

FIG 181

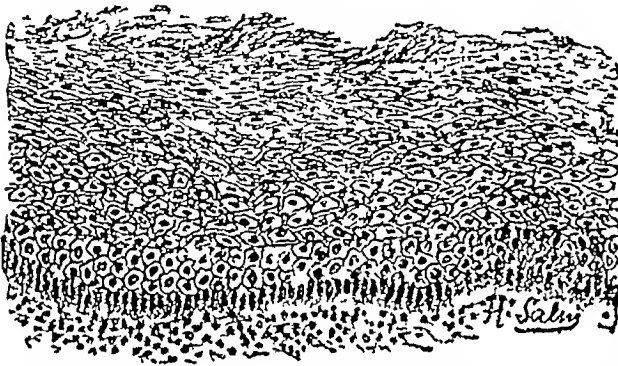


FIG 181—Superficial infiltration of the urethra in gonorrhea. Epithelial lining composed of many layers of pavement and of columnar epithelium (Motz) (Courtesy Wm Wood and Co from Luys on Gonorrhea)

FIG 182—Normal aspect of the upper surface of the penile urethra, with its lacunae of Morgagni and Littre glands (Courtesy of Dr Georges Luys)



ism as seen on the slide is that of a diplococcus usually found within (Plate III) the polymorphonuclear leucocytes.

PATHOLOGY OF GONORRHEA

The gonococcus attacks the urethral mucosa and invades the glands and crypts. The infection extends to the submucosa and may involve the corpus spongiosum and corpora cavernosa (Fig 52). The infection extends by continuity along the urethral mucosa and involves the prostate and seminal vesicles in the majority of cases. The extension of the gonococcus upward in the urinary tract is limited to the trigone (Fig 41). The rest of the bladder is immune to the gonococcus and gonococcal pyelitis, a few cases of which have been reported, is a rarity. The entire genital tract, (Fig 185) except the testicle, which apparently has a definite immunity against this organism, is readily involved in the extension of the process.

The testicle may be involved by extension in a severe epididymitis. In systemic infection, the synovial lining of the joints is most frequently involved in the proportion of one to a hundred cases of gonorrhea. Other tissues of the body can also be infected by the gonococcus or its toxin.

PLATE IV

A *Pneumococcus* and *Micrococcus catarrhalis* (Muir)

Film from sputum stained by Gram method. The pneumococcus (violet) retains the stain (Gram positive) while the *Micrococcus catarrhalis* has lost the stain, i.e. is Gram negative and has taken up the contrast stain (neutral red).

B Human type of *Bacillus tuberculosis* (Muir)

Film from sputum of case of pulmonary tuberculosis. Note numerous slender rods, straight or slightly curved, presenting a uniform or beaded appearance. They have retained the basic fuchsin dye whilst the other organisms have lost it and are counterstained with the methylene blue.

C *Treponema pallidum* (spirochete of syphilis) (Muir)

In upper left portion is typical appearance of the minute spiral organism as seen in dark ground illumination method, in exudate from chancre. In lower left portion, the spirochetes are stained purple by Giemsa's method. In the right middle portion the organisms are stained black by Fontana's method.



D



C



The local complications, such as peri urethral abscess and phimosis (Fig 185), are evidences of a specific local intensification of the process. Systemic infection usually cannot develop unless there is involvement of the posterior urethra and its adnexa. Epididymitis is the result of the extension of the infection from the seminal vesicles.

Chronicity and persistence of the gonococcus in the discharge are due to the persistence of the infection in the urethral glands, prostate, and particularly the seminal vesicles. The sequela of chronic anterior urethritis and stricture are the result of scarring and healing of the destroyed urethral mucosa. Chronic seminal vesiculitis is a sequel of posterior gonococcal infection in a large percentage of cases.

Gonorrhea is Very Often a Mixed Infection. The nonspecific bacteria normally present in the first two inches of the urethra, become activated and with the extension backward of the gonococcus these normally present nonspecific bacteria travel with it. Only with a proper understanding of the pathology of this disease can the importance of symptoms and findings be evaluated and treatment administered

PATHOLOGY OF ACUTE URETHRITIS (GONORRHEAL)

Invasion by the gonococcus. Within two hours and often sooner after exposure, the gonococci have penetrated the intercellular spaces of the columnar

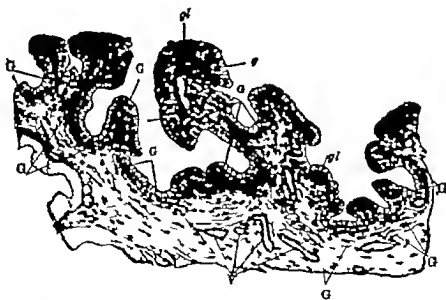


FIG. 183.—Histological aspect of the urethral mucous membrane in the penile portion
G Glandular Sinus or subepithelial tubalveolar glands. V Blood vessels (After von Lichtenberg and kindly loaned by Wm Wood and Co from Lays on Gonorrhea)

epithelium of the first two inches of the urethra. The fossa navicularis, the lacunae (Fig 182) and particularly the glands of Littre (Fig 182) which are very numerous in the first two or three inches of the urethra are the harboring places for the organisms. The infection begins at the fossa navicularis and persists longest there because at this point the urethra forms a blind pocket that is not well washed out with each urination thus allowing the organisms to remain and multiply. From this period of invasion up to the time the discharge and symptoms appear i.e. the incubation period the organisms have multiplied have invaded

the submucosa and with it there is already some extension of the inflammation along the mucosa

The urethral glands (Fig 183) are quite tortuous structures and dip into the submucosa. The crypts and glands do not all open toward the meatus, those back of the triangular ligament open posteriorly toward the bladder, those in front open toward the meatus (Fig 184). With the inflammatory reactions there develops a marked round cell infiltration of the mucosa and submucosa (Fig 181) and with it, the loss of elasticity of the urethra. The gonococci are found within and around the glands and it is here that the inflammation is most severe. The urethral mucosa is destroyed in places and desquamates, leaving the urethra denuded to be later replaced by a scar or by flat epithelium. With increasing severity of the infection, the corpus spongiosum and corpora cavernosa are involved in the infiltrative process. The dorsal lymphatics and the inguinal glands are also involved.

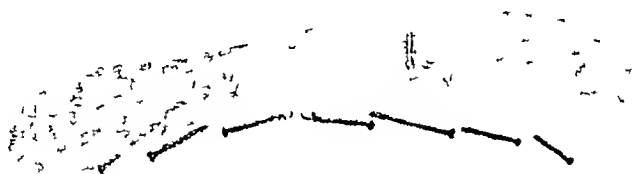


FIG 184.—Pin fragments inserted into a few of many lacunae of roof of human urethra. Some as shown by the pinheads open toward external meatus. These are in the anterior urethra. Other lacunae (as indicated by pinheads) open toward bladder. These are in the posterior urethra. (Dr W. T. Belfield.)

The infection extends by continuity along the mucosa involving all of the structures in its path including the membranous and prostatic urethra (Fig 185), in the majority of cases. The advance of the gonococcus in the urethra is at the rate of one inch a day, so that within eight to ten days, the posterior urethra is already involved.

It is important to remember that the organisms penetrate below the surface where they are inaccessible to medication, that they affect glands of microscopic size, the mouths of which point in various directions (Fig 184), and which are readily occluded. With the subsidence of the infection, the involvement is gradually limited to a few points along the mucosa where the infection has been most severe.

PATHOLOGY OF CHRONIC GONORRHEAL URETHRITIS

The pathological changes in this stage do not differ in general from those incident to the acute stage. The chief difference is that the changes are more localized in the form of a periglandular infiltration which undergoes cicatricial changes. The clinical evidence of infection in the glands and crypts (Figs 182 and 183) is the persistence of a mucoid or purulent discharge. The orifices of the glands become occluded and the glands themselves, obliterated.

On urethroscopic examination, one sees punctate reddish areas corresponding to the orifices of the infected glands and crypts associated with reddening of the mucosa (Plate I) and a disappearance of the folds of the urethral mucosa.

PLATE V

Autopsy of a guinea-pig, the left knee-fold of which was injected with the sediment of urine containing tubercle bacilli. Caseous material at the point of injection. Note also involvement of the lymph nodes as high up as the large abdominal vessels (Courtesy of Dr. Eugene Joseph of Berlin).



SYMPTOMS OF ACUTE GONORRHEA

Incubation Period This as a rule varies from three to ten days depending on the severity of the infection

Five Days is the Average Incubation Period The latter may in very severe cases be even less than three days and it is not at all rare to note an incubation period of ten to fourteen days

Prodromal Symptoms. During the incubation period, some symptoms may appear such as fatigue depression and loss of appetite

Onset. Before the discharge appears subjective sensations of tingling or pricking are often present and with the beginning redness at the meatus there is frequency of urination with some burning and a dull ache on urination The discharge is at first glairy and mucoid But within twelve hours it becomes purulent

Active or Flurid Stage This period varies from three to five or six weeks

LOCAL SYMPTOMS

There is redness and edema of the glans and meatus and eversion of the lips of the meatus In the hyperacute type the infiltration of the urethra is felt at the onset of the infection at first below the fossa navicularis and with the rapid extension the entire urethra feels hard

The discharge is at first thin and creamy but within 24 hours it becomes copious yellow and purulent and at the end of the first week is somewhat greenish The discharge at first contains pus and organisms later also the destroyed epithelium and debris, causing the change in color

Pain on Urination Varies Considerably In the mild cases there is a slight pain upon urination at the meatus and in the active infections the pain is often severe like the passing of molten metal i.e. a severe cutting pain

Pain upon Erection is Often a Distressing Symptom The inflamed urethra with the added congestion provokes enough irritation to produce frequent erections particularly at night

At times the erection is accompanied by bleeding as the result of tearing of the urethral mucosa Thus a vicinus circle is produced, the inflamed urethra stimulating erections and the erections aggravating the inflammation of the urethra. Due to the loss of elasticity of the infiltrated urethra and its failure to accommodate itself to erection the penis is bent downward the bend occurring usually a little behind the fossa navicularis This bending of the urethra with painful erections is the well known chordee In properly treated cases this complication is rarely observed.

Urinary symptoms present themselves first, as frequency

Nocturia is a Manifestation of Involvement of the Posterior Urethra. With infection of the anterior urethra alone urinary frequency may be noted by day but not at night Nocturia during the course of an acute gonorrhea is diagnostic of posterior involvement and may occur from one to five or six times during the night depending on the severity of the involvement in the urethra, prostate and vesicles

Urgency appears with bladder neck involvement, the desire to urinate being

frequent and with very little urine passed each time Tenesmus due to the spasm and irritation of the sphincters is an associated symptom

Frequent and painful ejaculation is an indication of seminal vesicle involvement There is pus and sometimes blood in the ejaculated semen

GENERAL SYMPTOMS

These are due to the systemic reaction from the local infection In the vast majority of cases, gonorrhea can be considered as a purely local infection with very little general reaction but in certain instances gonorrheal sepsis occurs

Period of Decline The gradual subsidence of symptoms with the early disappearance of nocturia and pain on urination, the second urine becoming clear, indicate the decline of the infection The discharge becomes less purulent and less severe During the first week, the discharge is quite profuse and is noted at the meatus every fifteen to thirty minutes With the decline, about the fourth to sixth week, the pus does not present itself at the meatus, except on squeezing or as a morning drop The reason for the morning drop is the accumulation of pus over night, during which period the patient does not urinate Later in the decline, the discharge becomes watery, the edema, redness and discoloration at the meatus disappear and the urine becomes clear

Course of Acute Gonorrhea Gonorrhea runs a regular course lasting anywhere from three weeks to three months, in the average case, usually from five to eight weeks There is an upward curve of increasing severity for the first ten days to three weeks, at which time the infection reaches its height At this time also, the extension to the posterior urethra, prostate and vesicles occurs and with it symptoms referable to involvement of these structures Usually, however, these last named symptoms are not marked and the infection remains stationary for about a week and then ensues a gradual decline until the end Posterior urethritis occurs in about eighty per cent and prostatitis in approximately forty to fifty per cent of typical acute cases

TYPES OF GONORRHEA

HYPERACUTE TYPE OF ACUTE GONORRHEA

In these cases, all the symptoms are markedly aggravated Due to lowered general and local resistance and a more virulent strain of the organism, the incubation period is only three or four days, sometimes less Extension to the posterior urethra with involvement of the prostate and vesicles may develop within the first week There is marked edema of the glans and prepuce The pain on urination is very severe and the urethral discharge may be bloody As a result of intense local and systemic reactions, the duration of the hyperacute type is very often much shorter than in the typical acute case The dorsal lymph vessel (Fig 54) is usually enlarged and palpable An inguinal lymph node infection may appear in the first days in these hyperacute cases 6-7 The hyperacute type is infrequent It may occur during the course of the acute type as the result of injections given at too short an interval, i.e. too frequently, as a result of the use of preparations which are too strong, as a result of lack of treatment and finally of coitus during an acute attack

SUBACUTE TYPE OF ACUTE GONORRHEA

This is quite common and may be mistaken by the clinician for a simple non specific urethritis. It may cause no distress, so that the patient may either overlook it or neglect to carry on treatment. The symptoms are very slight. The discharge is not profuse and there is only slight burning on urination. The period of incubation is relatively long seven to twelve days. Except for the presence of the discharge and slight cloudiness of the first glass (Fig 54) the patient usually presents no symptoms. The infection often lasts longer than the acute type because it produces very little local reaction of the tissues to overcome the infection.

SUBACUTE GONORRHEA

After an infection has lasted more than three months, it is then arbitrarily termed subacute. The infection usually is more localized in various parts of the urethra and there is also a persistent infection of the vesicles and prostate. The symptoms are not marked occasional nocturia, backache or perineal pain and some burning on urination.

In the division of acute gonorrhea into the hyperacute, acute and subacute types and into subacute gonorrhea there are some cases that do not fit distinctly into either of these groups. There are gradations between the hyperacute and acute and between the acute and subacute but the majority fall into the classification given.

COMPLICATIONS OF ACUTE GONORRHEA

The extension of the infection and the intensification of the process in the urethra and deeper structures and the systemic infection bring about the various complications.

POSTERIOR URETHRITIS

This occurs in sixty to eighty per cent of cases and is really part and parcel of the disease. It is not common, however in the subacute type of acute gonorrhea and in many cases can be prevented by early conservative treatment. Nocturia during acute gonorrhea is diagnostic of posterior urethritis. It may however not be present in very mild infections in which the second glass (Fig 190) is cloudy. Frequency during the day together with urgency is another characteristic symptom. There is tenesmus in the more severe cases sometimes accompanied by terminal hematuria.

Since as previously stated there is always an associated prostatitis and seminal vesiculitis the symptoms due to involvement of these structures are also prominent.

As in the clinical division of acute anterior urethral gonorrhea into the subacute, acute and hyperacute types so also in posterior urethritis we have the mild the usual or acute and the very severe types. In the mild or subacute type of posterior urethritis there is only occasional nocturia and often no frequency is present. There is very little or no urgency and no tenesmus and the second glass is only slightly cloudy. (See Fig 190)

In the more common form of acute posterior urethritis, nocturia appears two or four times and both glasses show distinctly cloudy urine. There is some

urgency and considerable tenesmus and the associated prostatovesiculitis is noticeably present upon rectal examination

The hyperacute type of posterior urethritis or prostatocystitis with terminal hematuria, is the more severe manifestation Terminal hematuria in acute posterior

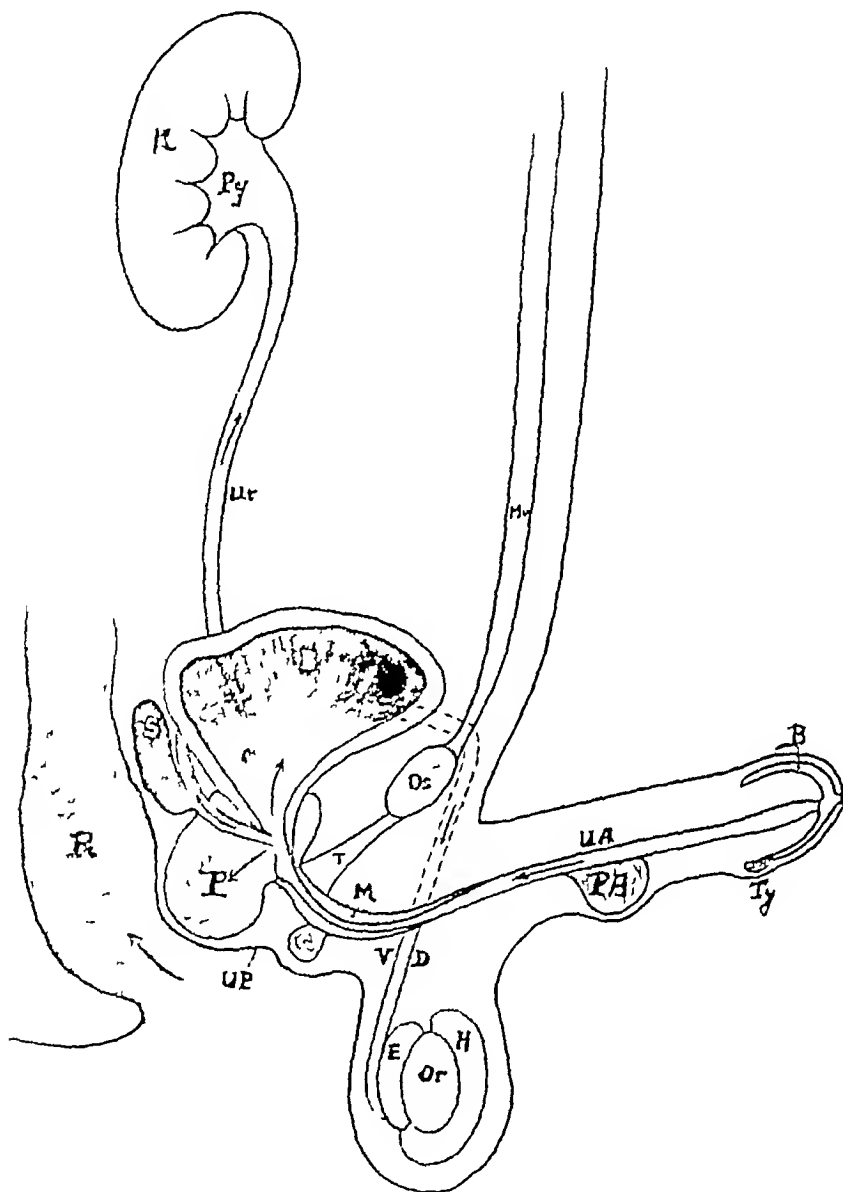


FIG. 185.—Diagram of complications of gonorrhea B, Balanoposthitis, Ty, Abscess of glands of Tyson, PA, Periurethral abscess, UA, Anterior, and UP, Posterior urethritis, M, Stricture at Bulbomembranous junction, C, Cowperitis, P, Prostatic abscess, S, Seminal vesiculitis, VD, Vas deferensitis, E, Epididymitis, Or, Orchitis, H, Secondary gonorrheal hydrocele, R, Gonorrheal proctitis

urethritis is diagnostic of prostatocystitis. The gonococcus in its upward invasion of the urinary tract does not go beyond the trigone so in this hyperacute type, the prostatic urethra and trigonal mucosa are chiefly involved. The edematous engorged prostatic urethral mucosa is torn when the compressor urethra squeezes out the last few drops of urine, producing hemorrhage and a terminal hematuria. There is usually an associated slight fever and all symptoms are markedly aggravated. The urgency and frequency are marked.

PROSTATITIS

The symptoms of prostatitis are those of the associated posterior urethritis together with those due to the congestion in the perineum edema of and pressure on the prostatic and membranous urethra, and referred pains due to tension on its capsule. They are due to the prostatic infection with periprostatitis in severe infection. In some, a periprostatic cellulitis and even a pelvic cellulitis may develop. Infections of the prostate and seminal vesicles will often present symptoms of posterior urethritis because of their intimate association with the bladder neck. In cases where the posterior urethra is only slightly involved. Here also as in acute anterior and acute posterior gonorrheal urethritis the symptoms of prostatitis vary with the intensity of involvement from those of very mild type to the very severe. Feeling of fulness and pressure in the perineum is one of the characteristic symptoms. This feeling of added weight and discomfort is also present in the gluteal regions so that the patient cannot sit comfortably any length of time and shifts while sitting from one buttock to the other. Long auto rides add to the discomfort.

Pain and itching in the rectum are common and together with some degree of constipation are due to mechanical interference from the engorged prostate and the congestion of the rectal wall and mucosa.

Referred pain to the hips and down the inner and outer side of the thighs is also often present. Interference with urination as the result of the edema and pressure upon the prostatic urethra may be only slight or may be complete causing acute retention. In the less severe cases the patient finds it somewhat difficult to start the stream and suffers some tenesmus. In the more severe cases there is a constant desire to urinate with marked tenesmus and pain. In the later development of this urinary difficulty the patient is able to pass only a few drops of urine with severe straining and then acute retention follows.

Acute catarrhal prostatitis or congestion of the prostate presents itself to the finger in the rectum as a slight rather soft enlargement and as a rule presents no distinguishing symptoms these being in the main similar to those of posterior urethritis.

Acute follicular prostatitis presents localized irregularities and infiltrated areas in one or both lobes. Very often they are more marked in one lobe than the other and in some cases involve an entire lobe alone. Fulness in the perineum and pain in the rectum with some referred pains to the hips and thighs are the usual symptoms.

Acute parenchymatous prostatitis shows diffuse involvement in both lobes, often so marked that the finger cannot reach the upper poles because the rectum is markedly compressed by the enlargement. The prostate feels hard throughout, occasionally a little softer in certain areas and a considerable amount of pus can be expressed with light pressure. All symptoms are markedly aggravated and some degree of interference with urination is found here. Acute retention often occurs, but a catheter can be inserted with very little difficulty indicating that edema of the mucosa is the cause. Backache is often quite marked and lower abdominal pain with referred pain to the glans, penis and meatus is also often present. The patient has considerable pain is in distress and has a fever of 99 to 102 or 103 F.

other epididymis usually becomes involved a few weeks or months later. Bilateral epididymitis, however, develops in only about ten per cent of the cases.

Gonorrheal epididymitis is practically never an epididymo-orchitis. The infection is limited to the epididymis (Fig 187) irrespective of the severity of the infection. Gonorrheal orchitis rarely occurs. The few cases of abscess of the testicle reported during a gonorrhea, mainly from the tropics, are due to other organisms.

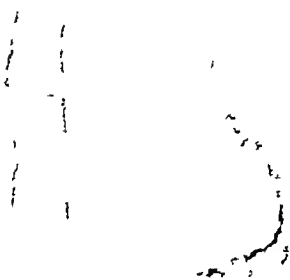


FIG 187—Human epididymis separated from testis except at head of epididymis. No fluid could be injected beyond epididymis.

As a result of the inflammatory edema about the verumontanum (Fig 47 and Plate I), the ejaculatory duct becomes temporarily occluded. Plugs of pus or mucus may also produce blocking of the ducts. The infected seminal vesicle and ampulla become distended with pus and being unable to escape through the duct, the pus finally regurgitates through the lumen of the vas to the tail of the epididymis (Fig 275).

As the result of active peristalsis of the vas deferens (no reverse peristalsis has been proven to exist)—the organisms and pus are propelled backward with each peristaltic wave of the vas toward the posterior urethra, the mechanism here being similar to that of bladder reflux.

The infection does not spread by continuity along the mucosa of the epididymis from the urethra, because the spread of the infection is too rapid. Neither can it travel along the lymphatics, for there is no continuous chain of these along the vas to the epididymis. Infection along the sheath of the vas could produce a periorchitis but not an epididymitis, for the sheath ends at the tunica vaginalis and covers it and does not continue within the tunica. Hematogenous spread of the infection from the vesicles or prostate would attack the head or body of the epididymis first, whereas in gonorrhea the globus minor (or tail) is always involved first.

Having arrived at the tail of the epididymis, the progression upward of the infection along the lumen of the epididymis is blocked. We have shown repeatedly that it is impossible to force fluid injected through the vas beyond the tail of the epididymis (Fig 187) irrespective of the degree of pressure exerted or the length of time this pressure is applied. Bacteria which have reached the tail of the epididymis are similarly prevented from progressing upward along the lumen of the epididymis. This we have also demonstrated in a series of experiments. With the increasing severity of the infection, the gonococci spread into the intertubular spaces from the lumen of the tubule, involve the interstitial tissue and then the infection spreads, involving the rest of the epididymis by peritubular and interstitial

extension, producing at first a periepididymitis of the body and head, rather than an epididymitis.

The infection and inflammatory reaction extend peripherally in the more severe cases, involving nearly all the coverings of the testicle and epididymis, the dartos and even the skin. The infection also spreads upward along the vas after having involved the tail the infiltration extending by continuity along the mucosa of the vas. In more severe cases, the entire spermatic cord is involved.

Symptoms of Acute Epididymitis. About forty-eight hours before the onset of the epididymitis, the patient may have some frequency of urination, supra pubic pain and sometimes an attack of terminal hematuria. Some degree of pain and tenderness on pressure in the iliac region on the side affected usually precedes the epididymitis, which is noticeable about twelve to twenty four hours later.

Epididymitis begins as a painful swelling at the tail soon becoming larger, together with increased pain and the early spread of the infection to the remainder of the epididymis and the tunica vaginalis. The skin of the scrotum becomes red and the scrotum increases markedly in size and the tenderness and pain are very marked.

Upon careful palpation, the epididymis can be distinctly separated from the testicle which it surrounds posteriorly. The testicle is very little enlarged and there is usually an associated hydrocele due to the inflammatory reaction in the tunica vaginalis. There is only a few cc. of fluid but there may be as much as thirty to forty cc.

The urethral discharge at the meatus either ceases entirely or at least decreases considerably as soon as the epididymitis becomes evident. With the subsidence of the epididymitis, the discharge reappears.

The symptoms of epididymitis subside in the average case about seven to twelve days after the onset but an induration of the tail of the epididymis may persist for months or even years. The cicatricial changes result in occlusion of the lumen of the tubules. Such obstructions cause sterility in over 75 per cent of the cases.

In the majority of cases, an epididymitis is the result of a mixed infection i.e. of gonococci and the nonspecific bacteria found under normal conditions in the first 2-3 inches of the urethra.

Cowperitis or infection of the bulbo-urethral glands (Fig. 9) This occurs in a mild form oftener than generally thought because it does not give rise to clinical symptoms. In typical cases, a swelling is to be felt on one or both sides of the perineum at the penoscrotal junction which must be differentiated by rectal examination (Fig. 112) from a periurethral abscess.

PERIURETHRITIS AND PERIURETHRAL ABSCESS (Fig. 188) Although this may occur anywhere along the urethra the most common location in acute gonorrhea is at the junction of the frenulum and the corona the so-called parafrenitis (Fig. 189) of Guérans. Folliculitis may appear in the first two or three inches of the urethra or it may appear at the penoscrotal junction. Deep seated periurethral abscesses are usually secondary to long standing inflammation complicating stricture. The periurethritis may extend to the corpus spongiosum and corpora cavernosa producing a hard band of infiltration that can readily be felt (Fig. 92) but which does not as a rule suppurate.

In periurethritis at the frenulum (Fig 189) the swelling presents itself during the second or third week with some degree of pain and particularly burning on urination, at this point The infiltration becomes larger and brawny and is usually more marked on one side It does not always progress to suppuration and may gradually recede In the majority of cases suppuration occurs and some fluctuation and discoloration is noted at its center When suppuration appears, incision is indicated to prevent a possible fistula

Periurethral abscess at the frenulum is common and the induration has often been mistaken for that of a primary chancre

Folliculitis at the penoscrotal junction may produce a large cyst or abscess appearing at the median raphe which may persist for a long time without producing much discomfort The other manifestations of periurethral abscess and fistula will be discussed under Stricture of the Urethra and Its Complications (Chapter 13)

FIG 189

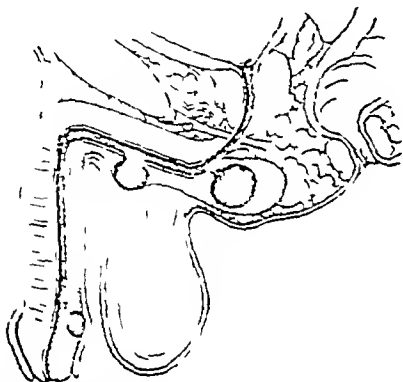


FIG 180

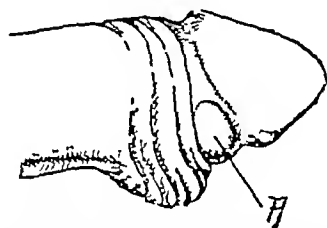


FIG 189—Diagram showing the most common locations of periurethral abscesses (After Papin)

FIG 180—Periurethral abscess in sulcus of glans Parafrenitis Urology by Guteras D Appleton Co

Intraurethral abscess is occasionally seen This is merely a folliculitis which does not point externally and has become walled off

It is usually found at the fossa navicularis and a bulbous bougie will open this as a rule

EDEMA

Edema of the prepuce with phimosis or paraphimosis (see Chapter 18) although usually occurring with genital ulcerations, is seen in the acute and hyperacute type of gonorrhea The edema often persists for weeks and months, becomes somewhat brawny and may persist for some time after the urethritis has disappeared

LYMPHANGITIS

Involvements of the dorsal lymph cord (Fig 54) with occasionally brawny edema of the entire penis is noted in the more severe cases Occasionally an abscess develops on the dorsum of the penis along the infiltrated cord (usually due to secondary infection) and may involve the corpora cavernosa

Inguinal adenitis is a frequent accompaniment of acute and hyperacute gonor-

rhea usually develops during the first week or ten days and disappears after a few days or a week. There is some pain and slight swelling in the groin. A gonorrheal inguinal adenitis rarely breaks down and is often associated with a dorsal lymphangitis that can be felt.

GONORRHEAL PYELITIS

Gonorrheal pyelitis is an infrequent complication and will be discussed in Chapter 39.

Résumé The history of exposure five to six days previous to the onset of a discharge, the presence of gonococci as determined by the methylene blue and Gram stain and the characteristic course and symptoms readily establish the diagnosis of acute gonorrhea. The triad of purulent discharge, angry meatus and painful urination is often enough to establish the diagnosis.

Urethral infection with discharge acquired during coitus may not necessarily be due to the gonococcus and a urethritis may emanate from systemic infection or a discharge at the meatus may appear as the result of infection of the deeper structures, the prostate and vesicles. Recurrences in gonorrhea must also, if possible, be differentiated from an acute infection.

ESSENTIAL FEATURES OF DIAGNOSIS OF GONORRHEA

DIFFERENTIAL DIAGNOSIS OF COMPLICATIONS OF ACUTE GONORRHEA

Balanoposthitis With considerable inflammation and redness of the glans and preputial mucosa, there may also be considerable pus accumulated beneath the prepuce. Upon superficial examination this may appear to come from the meatus but retraction of the prepuce and milking of the urethra will determine the source.

Chancroid and Phimosis. It is not at all uncommon to find that a diagnosis of gonorrhea has been made in cases in which there is a purulent discharge apparently coming from the meatus. Careful washing of the meatus and palpation of the infiltrated chancroids will determine the source of the pus as being extra urethral in origin.

Intraurethral Chancre This is often diagnosed as hyperacute gonorrhea. The presence of a rather thin watery discharge together with the relative absence of symptoms should make one suspicious. The presence of a syphilitic hubo and the finding of spirochetes will make the diagnosis. Meatal chancres may also be diagnosed as gonorrhea.

Chronic prostatovesiculitis with a discharge at the meatus can readily be differentiated by the slight amount of pus present, the absence of urethral symptoms and the presence of symptoms of deep seated infection together with the findings per rectum. It is well to remember however that a slight discharge at the meatus is common in vesiculitis.

Prostatorrhea and Spermatorrhea These are merely conditions in which there is a mild congestion or a low grade inflammation of the prostate and vesicles presenting itself with a discharge at the meatus. The discharge is thin, mucoid and not purulent.

Chronic Anterior Urethritis and Stricture⁴ A gleet morning discharge with a previous history of gonorrhea in the presence of infiltration or stricture is quite common. There is no evidence of inflammation and it can be readily differentiated. Alcoholic excess and coitus often produce a meatal discharge in chronic urethritis.

Urethrorrhea In some men, there is considerable watery secretion at the meatus and the latter appears red. There is an absence of purulent discharge and symptoms—merely an indication of active secretion from the mucosa. With prolonged erection, a sticky discharge appears at the meatus from hypersecretion of the urethral and Cowper's glands.

Meatitis Occasionally one may note a discharge due to inflammation of the meatal portion of the urethra. When this inflammation is prolonged, the meatus may become narrowed, due to fibrosis. It can readily be differentiated from acute gonorrhea by the absence of all symptoms.

Urethritis

SIMPLE URETHRITIS IN OLD AND DEBILITATED INDIVIDUALS Gout, diabetes, uric acid and lowered resistance from any cause will allow the organisms normally present to become active and produce a discharge at the meatus without any symptoms. In a routine examination of a large number of men, it is common to find a drop of pus at the meatus of which the individual is entirely unaware and which disappears in a short time.

CHEMICAL URETHRITIS The injection of strong irritants for prophylaxis will often bring on a discharge and cause considerable worry to the individual.

Continued or prolonged use of strong injections in the treatment of gonorrhea will cause the discharge to persist and lead both patient and physician to believe that the infection is still present. The discharge will also persist with prolonged use of sounds and prostatic massage. With cessation of treatment the discharge ceases.

ACUTE CATARRHAL NON-GONORRHEAL URETHRITIS This is often associated with an acute catarrhal inflammation of almost the entire genital tract. The discharge is mucopurulent, the patient usually has an associated catarrh of the upper respiratory tract and urinary frequency.

Rectal examination will reveal a concomitant nonspecific (catarrhal) prostatovesiculitis. This usually clears up in a few days.

The patient who has practiced coitus interruptus and already has some degree of prostatovesiculitis is a more likely subject for these attacks.

Such an acute simple catarrhal urethritis is a common occurrence and usually lasts but a few days. Following excessive coitus or an alcoholic debauch, a discharge may appear and last for a few days. Some patients are more subject to these attacks than others, so that one frequently sees recurrences.

Acute purulent discharge with absence of any organisms in the smear. This is occasionally seen. However, if repeated smears are made over an extended period, organisms, occasionally gonococci, will be found. In the onset of acute gonorrhea, one will occasionally find other organisms than the gonococcus in the smear, the first day or two of the infection. These are the nonspecific bacteria.

⁴ See Chapter 13 for discussion of stricture of the urethra.

normally present in the urethra which have become activated and appear in the discharge early, while the gonococci are still deep-seated

ACUTE NONSPECIFIC SUPPURATIVE URETHRITIS This may present the same symptoms as an acute gonorrhea and may result from coitus. This is the condition usually termed strain by the patient. The discharge is not profuse rarely if ever extends to the posterior urethra and presents very few symptoms. Like catarrhal urethritis it may clear up in a few days but often persists for many weeks and when the discharge is profuse must be treated along the same lines as a gonorrheal urethritis. One should not be too hasty in making a diagnosis of a nonspecific urethritis. Very often it is a mixed infection with the other organisms predominating at first and then later the gonococci appear in large numbers in the smear.

SUBACUTE GONORRHEA

During the course of an acute gonorrhea the discharge will clear up and apparently the gonococci have left the urethra. After a few days without treatment or as the result of an intercurrent cold, sexual excitement or ingestion of alcohol the discharge and gonococci will reappear. After judicious treatment for a period of six to eight weeks with apparent clearing up of the infection in some cases there will often be recrudescence although slight of the discharge with gonococci present.

The vast majority of the cases of subacute gonorrhea are those which continue to discharge for a period of over three months without remissions and persist until the fourth, fifth or sixth month after onset of the infection. Beyond six months the infection is termed chronic. Some cases of the mild subacute type of acute gonorrhea may persist for a long time and become subacute in duration without any other symptoms or findings than those of an anterior urethritis. The other prolonged infections may be due to the persistence of the gonococci in glands and crypts of the urethra (Fig 183) alone but there is usually also an associated persistent infection of the prostate and vesicles.

The symptoms of subacute gonorrhea are merely those of the discharge with some pain and burning on urination, together with evidence of subacute vesiculitis and prostatitis. When the infection persists over a period of six months it is as stated above termed chronic.

CHRONIC GONORRHEA

The persistence of the infection for a period of six months to a year or more is due to the harboring of the infection in the crypts and glands of the urethra (Fig 183) or in the prostate and vesicles (Figs 50 and 185) or both. Chronic gonorrhea may be limited to the anterior urethra but chronic posterior urethritis, *per se* is rare.

Chronic posterior urethritis is always secondary to infections of the prostate and vesicles. In the majority of cases chronic gonorrhea is due to the persistence of gonococci in the seminal vesicles (Fig 50).

In these protracted infections there are often short periods when there is no discharge at the meatus and the urine is almost clear. In other cases gonococci will only be found occasionally and the patient is apparently well until a few gonococci reappear in the discharge. In others there may at intervals be a

recrudescence of the discharge and some increase in symptoms with showers of gonococci, lasting only a few days

A chronic folliculitis or periurethritis will occasionally flare up and cause discharge of gonococci. This can often be brought about by massaging the infiltration over a sound (Fig 92). Occasionally after the discharge has become chronic, there may be a sudden lighting up of the process as the result of a generalized "cold," sexual excess or ingestion of alcohol, and the infection again passes through the typical course of acute gonorrhea with all the usual symptoms.

There are many infections which occur in men who are constantly exposed or who have been infected a number of times, which are difficult to classify. As stated previously, one infection predisposes to another, but paradoxically, succeeding attacks are rarely as severe. They seldom follow the classical course or present the symptoms of an acute gonorrhea developing for the first time. Some men resume the sex habit as soon as the symptoms and discharge at the meatus have abated or disappeared. By doing this, they prolong the duration of the infection, there is flaring up of the discharge at intervals and very often a new infection becomes superimposed on the old one. There are many men who are constantly suffering with gonorrhea, due to the persistence of the chronic gonorrheal superimposed infection. The reinfection of the urethra takes place as the result of the chronic vesiculitis present and the superimposed infection that often results with frequent exposure. It is difficult therefore, to determine in these cases when a fresh infection has occurred. It is also equally as difficult to determine whether the flaring up of the infection at intervals, is a fresh attack or merely the chronic gonorrhea.

The symptoms of a chronic gonorrhea are those due to the urethral infection together with the prostatovesiculitis.

CHRONIC PROSTATOVESICULITIS

The infection may persist for a long time without giving rise to any particular symptom. As a rule, the patient complains of a number of symptoms which should direct the attention of the clinician to these structures.

1 Persistent pain or a feeling of fulness and weight in the perineum is a common symptom.

This is associated with pain referred to the rectum, or a dull ache and feeling of pressure over both inguinal regions sometimes referred to the testicle or thigh, together with a feeling of pressure over the bladder region (suprapubic).

2 Backache is an outstanding symptom. Every case of backache in the male requires a rectal examination for the purpose of determining the presence of pathology in the prostate and vesicles. The backache is due to the inflammation and tension on the prostate and vesicles, which are well supplied with sympathetic nerves.

With these symptoms, together with a discharge at the meatus or shreds in the urine, the diagnosis of involvement of the prostate and vesicles is almost assured. However, not until rectal examination combined with the examination of the expressed secretions (Fig 111) of the prostate and vesicles, showing the presence of pus and gonococci, has been carried out, can one be sure of such involvement.

3 Urinary frequency noticeable during the day with occasional nocturia is a common symptom of prostatovesiculitis. At times there may be urgency and burning on urination when the infection flares up.

4 Pain and burning along the course of the urethra and particularly pain referred to the region of the *fossa navicularis* sometimes to the glans penis, is also a characteristic symptom.

5 Frequent nocturnal emissions with some pain on ejaculation are present during the early months of the infection. In persistent prostatovesiculitis the patient notes some pain and burning in the urethra during coitus and after ejaculation. Potency is often considerably reduced and there is also lack of sexual desire.

6 Sexual neurasthenia is often secondary to chronic prostatovesiculitis. Although it is true that many sexual neurasthenics are merely neurasthenics in the general sense of the term, a large number also have some definite disturbance in the prostate and vesicles. A careful examination should be made to exclude this. Neurasthenic symptoms are a frequent association and are often present in nervous individuals after gonorrhea. These latter are difficult to handle; they often travel from one urologist to another and become the prey of the quack. A shred or two in the urine or peculiar odors about the genitals are a common complaint.

7 Rheumatic manifestations with pains and aches in various parts of the body and with arthritic and bone changes are due to the persistent infection of the prostate and vesicles as the foci.

These will be discussed more fully later in this chapter.

The symptoms of a chronic gonorrheal prostatovesiculitis vary considerably. Only one or two of the major symptoms may be present, but if the infection persists most of the above mentioned symptoms appear.

The diagnosis is of course made only with the aid of the finger in the rectum (Figs 109, 110 and 111). The prostate is usually somewhat irregular and at places nodules can be felt. Often it is smooth and somewhat boggy. The vesicles are usually not palpable. Where the infection is fairly active or has been severe there is an induration over the vesicle of one or both sides, usually marked on both sides. Massage of the vesicles produces considerable pain and the expressed secretion of the prostate and vesicles as it appears at the meatus or in the third glass shows either solid pieces of pus or the pus may be microscopic. The characteristic muco-purulent wormy shreds, rubbish, expressed from a chronic vesiculitis (Plates VI and VII) will usually also show spermatozoa, some of which may be motile. Chronic vesiculitis and prostatitis will be covered more fully in Chapters 18 and 19.

RECURRENCES IN GONORRHEA

Recurrence is usually due to the flaring up of a latent infection in the seminal vesicles. The infection may also be in the prostate or in the urethral glands (usually at the site of a stricture) and be dormant only to be activated after a varying period of latency.

Recurrences usually appear within one year (after apparent cure of the infection). They are not uncommon two or three years later, and in rare cases may appear ten and fifteen years after the initial infection.

It is well to remember, however, that while recurrence is not rare, most of the so-called "come-backs" are really new infections. A careful history should be elicited in establishing the diagnosis of a recurrence.

The patient may or may not have noticed a slight mucoid discharge for a few weeks before the appearance of the purulent discharge. Many have a persistent catarrhal discharge following a chronic gonorrhea, presenting, however, no gonococci in smears. The usual history is as follows:

A man apparently cured of his gonorrhea has married and as the result of excessive coitus during the early weeks of married life, the infection reappears. In others, a prolonged sexual debauch may produce the same flare-up.

An alcoholic excess with or without coitus often brings about the discharge. Hard work or straining, a blow or injury to the perineum or an intercurrent infection may cause a flare-up.

Following the passage of a sound, the discharge may appear as the result of the irritation or breaking up of the latent infection in the crypts and glands. In latent chronic vesiculitis, the passage of a sound may suddenly produce an epididymitis. Recurrent epididymitis is, of course, an evidence of the persistence of the infection in the vesicles.

There is usually no incubation period, the discharge appearing the next day after coitus or the passage of a sound. There are no symptoms associated with the discharge and this persists from a few days to a few weeks. If the patient is seen early, the smear shows degenerated leukocytes, considerable epithelium and the gonococci are extra-cellular. The gonorrheal complement fixation often is positive.

CHRONIC ANTERIOR URETHRITIS

The persistence of a "gleety" discharge at the meatus following a gonorrhea (the gonococci having disappeared) is usually the only symptom of a chronic anterior urethritis. A discharge at the meatus is also present with stricture of the urethra. The demarcation between a chronic anterior urethritis and a urethral stricture is not very definite but an infiltration which will not grasp a No. 26 sound or will allow a larger size to enter, is characteristic of chronic anterior urethritis, rather than of stricture. Some fibrous strictures at the fossa navicularis and an occasional stricture elsewhere, cannot be so readily differentiated by this rule. The borderline between a chronic urethral gonorrhea and a chronic anterior urethritis is not distinct, the former gradually merging into the latter. In a chronic anterior urethritis there is some infiltration and scar formation but very little tendency toward narrowing the lumen of the urethra. A chronic anterior urethritis practically never becomes a stricture and is usually the result of a prolonged infection or persistent over-treatment.

Pathology. The pathologic changes producing a chronic anterior urethritis are the scarring of the urethral mucosa and distortion together with persistence of the infection in the glands and crypts.

There develops a sclerosis of the mucous membrane together with inflammation of the crypts and glands in the area affected. The inflammation within the glands persists as a chronic catarrh (glandular urethritis of Oberlaender) or with the occlusion of the glands and cicatrization, there may be very little discharge (dry urethritis of Oberlaender).

Urethroscopically (Plate I) the folds and striae of the urethral mucosa are considerably diminished and the inflamed orifices of the ducts and crypts are seen. The urethra has lost its elasticity. This is the soft infiltration of Oberlaender. There is considerable folliculitis and periurethritis that can be felt over a sound (Fig. 92).

In the more chronic and persistent infections the urethral mucosa becomes pale or grayish in color at the points of involvement with normal tissue adjacent. There may be white areas of leukoplakia and in some places heaping up of scar and epithelium and the production of hard bands. The folds (Plate I) are entirely obliterated. A whitish scar is seen together with a few small punctate areas of inflammation of the gland orifices. This is the hard infiltration of Oberlaender.

The changes may become more marked and produce a stricture. With the gonococci gone, other secondary organisms keep up the inflammation.

Symptoms. The morning drop due to the fact that the patient has not urinated during the night is characteristic. There may be some discharge during the day but usually it is not noticeable. The scars of battle with the gonococcus, the lack of resistance to the organisms normally present and the secondary infection on a soil with lowered resistance keep up the discharge.

Aside from the discharge there may be occasional slight burning on urination and often there is an irregularity in the urinary stream, the stream twisting in various directions.

In some there is no discharge but shreds persist in the urine. The morning drop or the presence of shreds in the urine may persist more or less continuously for a number of years without presenting symptoms and without responding much to treatment. As a rule with these persistent chronic infections in the anterior urethra, the gonococcus itself has disappeared after the first year.

Such cases often however present a difficult problem in the decision as to whether marriage is permissible.

Diagnosis. The diagnosis is based on the absence of any findings in the prostate and vesicles, the two-glass test and the presence of mucous or mucopurulent shreds that float in an otherwise clear urine. The palpation of the infiltrations over a sound is diagnostic (Fig. 92).

The discharge at the meatus (Fig. 93) presents some mucus, considerable epithelium and a fair amount of pus. Occasionally it is made up almost entirely of mucus and epithelium.

It is particularly here that the urethroscope has its place. The scarred urethral mucosa and infected glands and crypts on the dorsal surface of the urethra (Plate I) can be distinctly seen. One can determine definitely by urethroscopic examination the amount of involvement and its location.

URINE IN GONORRHEA

PHYSICAL CHARACTERISTICS

Phosphaturia is the most common condition that requires differentiation.⁵ Often however the turbidity may be most marked with the expulsion of the last few drops of urine indicating that its source is in the seminal vesicles. Urates and pus in the urine also present definite appearance. With a large amount

⁵ See Chapter 8 for exclusion of phosphates and urates as sources of urinary turbidity.

of urates, there is a brick-red color to the urine and a reddish sediment readily appears. Pus gives a distinct grayish, dirty appearance to the urine, which can usually be differentiated by simple tests from phosphates and urates. Urates disappear upon heating and phosphates upon the addition of a few drops of acetic acid.

TESTS

The Glass Tests (Fig 190) With the disappearance of the discharge at the meatus, the patient and often even the physician, will consider the gonorrhea as cured. A considerable amount of pus and shreds may be present in the first seven or eight inches of the urethra without being apparent at the meatus. It is for this reason and for the purpose of locating the source of the pus and shreds, that the glass tests are employed. They are employed routinely in all examinations and preliminary to treatment and are almost as important as the microscope.

Thompson's Two Glass Test (Fig 190) The patient having retained his urine for at least one hour and preferably two or more, urinates into two glasses. He should pass at least six ounces into the first glass before passing the rest of the urine into the second glass. The purpose of the test and its value is to determine the presence of pus in the anterior or posterior urethra or both. In the presence of infection of the anterior urethra, only the first glass will show pus or shreds and the second glass will be clear. With infection of the posterior urethra, both the first and second glasses are cloudy. Pus in the anterior urethra remains in the urethra and is washed out with the first few ounces of urine. Any appreciable amount of pus in the posterior urethra gravitates toward the bladder from the prostatic urethra as the result of the contraction of the external sphincter overcoming that of the weaker internal sphincter (Fig 49). The pus reaching the bladder mixes intimately with the urine and thus the second and succeeding glasses are cloudy as well as the first. Although the second glass test properly made is fairly accurate there are exceptions to the usual deductions drawn from it.

In mild posterior urethritis, also in subacute and chronic prostatovesiculitis, very little pus may accumulate in the prostatic and bulbous portions of the urethra (without gravitating to the bladder), and remain until washed out by the first gush of urine, so that the first glass is cloudy and the rest clear.

In subacute and chronic prostatovesiculitis, the first glass may be clear and the second glass cloudy. This latter is due to the compressor urethra and levator ani (Figs 49 and 55) muscles squeezing the ducts of the prostate and seminal vesicle and expelling some pus at the end of urination.

Posner's Three Glass Test The patient urinates as before into two glasses, but retains some urine in the bladder. The prostate and vesicles are then massaged and he urinates again into a third glass thus emptying his bladder. The first and second glasses show pathology in the anterior and posterior urethra and the third glass contains the secretion of the prostate and vesicles. The appearance of the urine after prostatic massage (Fig 111) is characteristic. It is somewhat opalescent, albuminous and hazy. Pus presents itself as a diffuse cloud or by characteristic shreds or specks of pus. Sometimes the apparent cloudiness is due to spermatozoa. Shreds from the prostate and vesicles should be

examined at once, because the acid urine disintegrates the alkaline shreds. Normally some pale small gelatinous crystals can be massaged out of the prostate and the secretions of the vesicles may appear as mucus and spermatozoa.

The two and three glass tests usually answer all purposes.

Shreds in the Urine. Shreds consist of pus (Plates VI and VII) or they are mucopurulent consisting of pus mucus and epithelial cells. In chronic catarrhal urethral discharge the shreds may be entirely mucus but there is

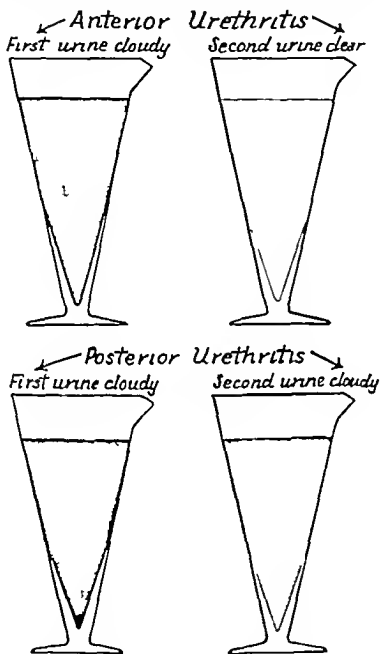


FIG. 190.—Glass tests in anterior and posterior urethritis

usually some pus present. Pus shreds are heavy and sink to the bottom of the glass. Mucus shreds are light and float in the urine. The mucopurulent shreds gradually settle after floating around for a short time. In some cases of active soft infiltration or stricture the particles of pus may be so small and diffuse as to give a "sandy" appearance to the urine. Shreds in an otherwise clear urine, indicate a chronic or inactive process. Purulent urine with shreds indicates an acute or active inflammation. Some shreds contain considerable epithelium

Pus shreds from the urethra in acute gonorrhea are produced by the accumulation of pus in the folds of the collapsed urethra with some mucus

These adhere to the wall of the urethra, so that both pus and mucus are washed out with the urination. These pus shreds are small, a little long, irregular and look like broken off pieces of onion.

Shreds coming from the prostate have the appearance of specks and are not particularly characteristic except when they present the typical Furringer "hooks."

The floating catarrhal shreds of a chronic anterior urethritis are flat, irregular and do not reach large dimensions.

Long, stringy, mucus shreds, even if found at the meatus, probably come from the vesicles. Shreds and debris coming from the seminal vesicles are worm-like in appearance due to having been squeezed through the tortuous ejaculatory ducts (Fig. 50).

Pus from the vesicles, as also the shreds, often appear as large casts of the vesicle.

Shreds Should Be Examined Microscopically as Well as Grossly. Pus and gonococci can be found. In shreds from the vesicles, considerable mucus and some sperm may be seen.

Following massage of the prostate and vesicles, some expressed secretion may appear at the meatus and the shreds may be found here. In chronic anterior urethritis also, a few of the shreds may be found in the first drop on the slide.

Complement Fixation Test. The value of the gonococcal complement fixation test is debatable. Some lay great stress on its usefulness but its practical value is very limited. It may be a diagnostic aid, however. One can diagnose a recurrence, if the test is positive, with the onset of the discharge, indicating that the infection has existed for some time. In acute gonorrhea it does not become positive until five or six weeks have elapsed and often remains positive many weeks and months after complete cure if the infection is posterior. It cannot serve as a guide for treatment or cure.

PROGNOSIS OF GONORRHEA

The vast majority—i.e. 85 per cent, are cured within the first three months and although developing a varying degree of prostatovesiculitis, clear up and remain well.

In the other 15 per cent, epididymitis, persistent infection of the urethra, prostate, and vesicles and systematic complications develop. The infection may become latent and apparently cured, only to recur again upon provocation. Chronic anterior urethritis is not an uncommon sequel and strictures and infiltrations develop in about 4 to 5 per cent of the cases.

The gonococcus leaves the urethra as a rule, after the first year of a persistent infection and is replaced by secondary invaders. It may remain in the vesicles for a considerably longer period. With judicious, early and continuous treatment during the acute stage, the vast majority—(90 per cent or more) are cured and remain so until reinfected. It is the impression of many laymen and some physicians that gonorrhea is not curable and that it persists for many years. This is, however, entirely erroneous.

PROPHYLAXIS OF GONORRHEA

Continence for some individuals and the abstinence from illicit coitus are the definite safe prophylactic measures

The use of a condom is prophylactic. Care must be used in determining whether the condom has broken and also in its removal after coitus, so that the infected external surface of the condom does not infect the meatus

During the World War the value of chemical prophylaxis after exposure was definitely shown by many and was proven in our personal experience with troops. The prophylaxis proved of no value if employed more than six hours after exposure. It was of some value up to the third and fourth hour after exposure and gave very satisfactory results if administered within the first hour after coitus.

Washing the parts with soap and water and urinating immediately are measures which should be employed preliminary to chemical prophylaxis. The injection of two per cent protargol retained for three or four minutes is a satisfactory prophylactic. Calomel ointment 50 per cent applied externally and allowed to remain on for a few hours is an excellent prophylactic against syphilis

SYSTEMIC AND EXTRAGENITAL GONOCOCCAL INFECTION

SYSTEMIC INFECTION

The group of symptoms and their underlying pathology termed gonorrheal rheumatism constitute the chief manifestation of a systemic infection. This is the result of an invasion of the blood stream by the gonococcus or its toxin or by both of these

Certain of the systemic infections such as septicemia, endocarditis and acute arthritis with effusion are due to the gonococcus itself while others, such as the eye and skin manifestations are probably due to the toxin rather than the organism.

Systemic Manifestations are not Rare. They are probably found in three per cent of the cases or more in one form or another. The reaction of the body to the infection is the most important agent in the cure of gonorrhea hence it is hardly surprising that occasionally the toxins or the bacteria will overcome the resistance of the host and invade the blood stream

The gonococcus complement fixation which becomes positive in the latter part of the infection is merely a manifestation of systemic reaction and some protective mechanism. The usual time of appearance of the systemic manifestations is between the third to fifth or sixth week coincident with the decline of local symptoms. They may however develop during the first week or much later from a persistent focus in the prostate and seminal vesicles

Transitory Gonococcus Sepsis In this condition there is a persistent high fever with very little urethral discharge and no local symptoms. In the vast majority of cases gonorrhea is a local infection with only slight systemic reaction thus permitting the patient to carry on and be up and about

The source of the fever may be overlooked. With but few exceptions systemic infection takes place when the posterior urethra is involved. This portion

of the urethra has a very rich blood supply, so that absorption takes place much more easily than in the less highly vascularized anterior portion. There are undoubted cases of sepsis, however, from anterior urethral infections alone.

In transitory sepsis, the patient has chills, fever, leukocytosis and runs a septic course for a week or two, the organisms being sometimes found in blood cultures. The condition clears up rapidly and is never fatal.

Gonococcus Sepsis with Cardiac Complications Gonococcus endocarditis is rare—about one in fifty thousand cases.

Myocarditis and pericarditis probably occur a little more frequently, although the myocardial changes may be similar to those of any febrile state.

Mild types of gonococcus endocarditis involving the mitral valve, producing but few symptoms or findings, have been described. The definite, clinically characteristic picture is that of a severe infective, ulcerative or malignant endocarditis, involving the aortic valve in the majority of cases. There is practically always an associated arthritis or myositis.

The course of the endocarditis is similar to that of all types of malignant endocarditis. There is intermittent fever with showers of emboli, sepsis is present and the termination is always fatal.

Septicopyemia with localization of abscesses in the joints and various organs has been described.

Gonorrheal Arthritis As stated previously, this includes the vast majority of cases of gonococcus sepsis. It develops in one to two per cent of acute gonorrhea cases and the incidence is greater with the development of chronic prostatovesiculitis. The focus of the infection is nearly always in the seminal vesicles, but often in the prostate as well. While it usually appears during the third to the sixth week of an acute gonorrhea, it may develop much later, when the urethral infection has apparently been cured but there is still a persistent focus in the seminal vesicles.

Instrumental trauma, forceful massage during the acute stage of prostatovesiculitis and trauma from irritating injections, may bring on an attack of gonorrheal arthritis.

The joints most commonly affected are those of the lower extremities, the ankles and knees, particularly the latter and the metatarsals. The hip is next most commonly involved, then the temporomaxillary, finger and wrist joints. The involvement may be monoarticular or polyarticular. It is usually polyarticular with predominant involvement of one joint, most commonly the knee joint. The pathologic changes in the joint vary with the intensity and the duration of the infection. There may be only a slight effusion or plastic inflammatory exudate formed or the articular ends of the bone, the periosteum and the bone itself may be affected, producing destructive changes which become permanent. Many of the acute cases respond to treatment without becoming chronic. Others become chronic, often from lack of proper care of the focus of the infection, viz., the seminal vesicles.

Acute Gonorrheal Arthritis This systemic complication may be present as a fibrinous exudate or with an effusion. In some it is phlegmonous with a little effusion, often serosanguinous or bloody. In rare cases, pus may be present in the joints. In these there is marked destruction of the joint. The gonococcus does not produce pus in arthritis as a rule and in the rare cases of joint suppuration

a mixed infection must be considered. The effusion in the joint may be considerable. There is distinct fluctuation and the fluid, which is a straw colored exudate, may be as much as 70 to 100 cc, usually about 20 to 30 cc. The fluid reappears after aspiration although usually not in the same amount. In the fibrinous type there are considerable pain and tenderness which are not so marked in the effusive type. There is an intermittent fever, some chills and leukocytosis.

The acute form of gonorrheal arthritis requires differentiation from rheumatic arthritis. There is not the severe sweating or the marked anemia or the excruciating pain of acute articular rheumatism, neither does it shift from one joint to another as does the latter and it is more prolonged and subacute.

Above all there is the associated urethral discharge and the finding per rectum, of involvement of the prostate and vesicles together with the finding of the gonococci in the urethral discharge. In the first few days of the onset of the effusion in the joint, the gonococcus can often be found. During the acute stage or during an exacerbation it may be found in the blood.

Chronic Gonorrheal Arthritis. When the condition becomes chronic there are deforming changes in the synovial membrane, the cartilage and bone producing a varying degree of ankylosis, sometimes quite marked. Often however even the chronic joint involvement of many months or even a few years duration, will improve considerably with the eradication of the focus in the seminal vesicles, indicating that in some, the joint changes are not of a permanent nature.

The chronic gonorrheal form of arthritis with hydrops usually follows the acute, but may be insidious from the onset. The joint is large, there is some fluctuation and the contents upon palpation feel like rice bodies. There is also often some free fluid. The knee joint is most commonly affected. In the chronic ankylosing type the joint is somewhat large, there is no effusion but there is fibrous capsular thickening and destruction of the cartilage with more or less loss of mobility of the joint.

There are intervening stages from the acute to the chronic arthritis and the various changes may be present in the same joint.

Gonorrheal Osteoperiostitis. Although often associated with the arthritis it also occurs separately from it. It may occur in the fingers and other bones. A perichondritis of the ear has been described but the classical location for periostitis is the os calcis, producing the painful heel of gonorrhea and with prolonged involvement the gonorrheal spurs. These spurs are visible in x ray films and are diagnostic.

Gonorrheal Myositis. This is often associated with an arthritis and is especially found in the hips, thighs and in the arms. With all these manifestations of gonorrheal rheumatism there is usually a slight discharge at the meatus or shreds in the urine. In the protracted cases there may be no findings in the urine and there may be very little evidence obtained from the prostate and vesicles because of the chronic changes that may have taken place there.

Arthralgia. Gonorrheal arthralgia manifests itself by pains in the various joints, e.g. shoulders, knee or ankles without any demonstrable pathology in these structures. The pains are usually transitory and occur usually during acute gonorrhea, but may also appear in chronic gonorrhea.

Gonococcal Bursitis. Involvement of the bursa of the tendo achillis and the prepatellar bursa is sometimes seen.

Synovitis This is a common manifestation, almost as common as the arthritis and often associated with it, involving usually the tendon sheaths around the ankle and wrists. There is distinct swelling and some redness, this persisting for a variable period of time but not as long as the arthritis or the bone involvement.

Thrombophlebitis This is rare. Any of the veins of the extremities may be affected. Local thrombophlebitis may involve the dorsal vein of the penis.

Pulmonary complications are pulmonary infarcts and pneumonia, which is embolic in nature, with a secondary pleurisy. All are rare.

The skin complications of gonorrhea while uncommon, probably occur oftener than suspected. They are due to the toxin of the organism and are usually associated with gonorrheal rheumatism. They usually occur during the acute stage of the infection. Four types have been described, three of which are similar

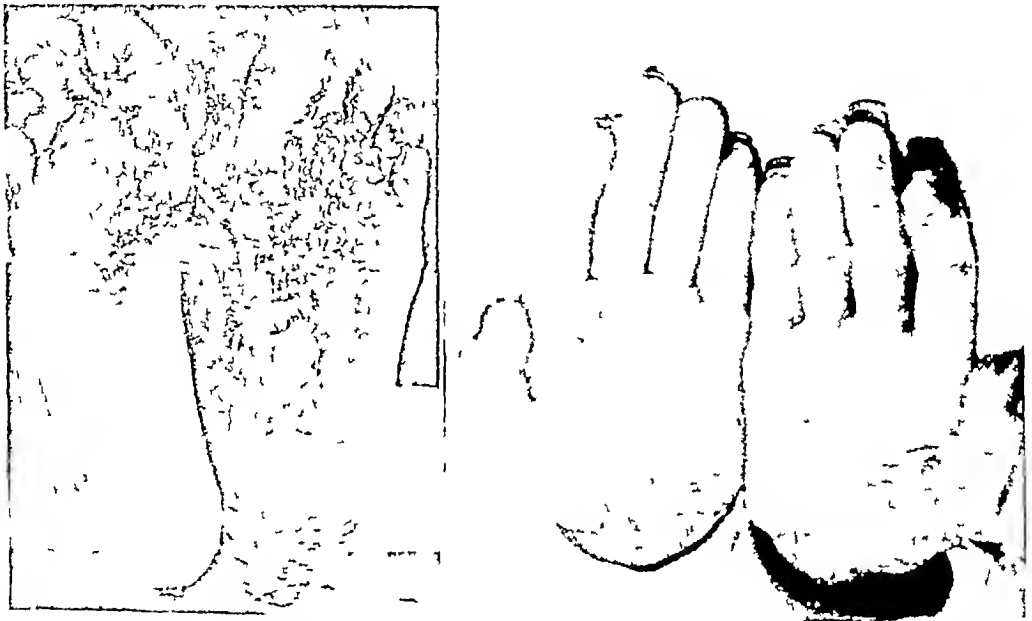


FIG. 191—Keratoderma Blennorrhagica. Note trophic changes in nails of terminal phalanges of fingers.

to those due to other septic organisms, viz., simple erythemas, scarlatiniform or resembling German measles, urticarial and hemorrhagic spots. Keratoderma blennorrhagica is a rare type of hyperkeratosis producing horny excrescences near the joints or on the plantar and palmar surfaces (Fig. 191). It is usually associated with arthritis and a urethral discharge.

Nervous complications occasionally occur. Peripheral neuritis in association with an arthritis is sometimes seen. Myelitis and encephalitis have been described. Meningitis due to the gonococcus has been described, the difficulty in differentiating the gonococcus from the meningococcus leaving very few authentic cases.

EXTRA-GENITAL GONORRHEAL INFECTION

Gonorrheal ophthalmia developing in an adult with a gonorrheal urethritis, is a rare occurrence. When one has seen thousands of neglected cases of gonorrhea passing through a large clinic over a period of a number of years, it is

surprising to note the rarity of this complication. We can recall only two cases. It is evident that with the onset of the urethral discharge there develops some immunity of the other external mucous membranes, because it is impossible otherwise to explain the rarity among those ignorant and careless patients seen in the clinics, who do not protect their eyes.

Primary gonorrheal ophthalmia in the adult is however, not rare. We know of five medical students and doctors who in the last four years have had one eye enucleated due to direct infection of the eye from infected liquor amni and vaginal secretions, at the time of rupture of the amniotic membrane. Other cases may result from careless handling of the penis in the examination and treatment for gonorrhea and then rubbing or contaminating the eye. The infection may also result from infected towels or in the bath or swimming pools. The individual suffering from gonorrhea should be instructed against possible infection in this manner not so much for his own personal safety as for the others in the household.

The patient with gonorrhea should be instructed to prevent possible infection of his eyes by washing his hands after contact with the genitalia and the proper care of his linen.

Gonorrheal ophthalmia in the adult is a very virulent and severe infection and in most of the cases results in destruction of the involved eye with the added danger of infection of the other eye and sympathetic ophthalmia producing total blindness.

The incubation period is usually short from three to four days, the onset is rapid and the discharge appears early. It begins with a swelling and redness of the lids with edema of the ocular conjunctiva and considerable pain and headache. A profuse discharge develops with an involvement of all of the structures about the eye—i.e., a panophthalmitis. The discharge is so profuse that during the active stage it reappears within ten minutes after the eye has been irrigated. The infection follows the course of an acute gonorrheal urethritis the discharge persisting for about three weeks and then gradually subsiding. During this time the cornea becomes involved and there is scarring and retraction of the eye and the lids with destruction of the eye.

As a rule one eye only is involved at a time and with constant attention both day and night, the patient being kept in a dark room and a shield over the other eye to protect it the infection may be limited to the one eye. The danger of sympathetic ophthalmia often requires removal of the infected eye.

Anorectal Gonorrhea. This is seen occasionally in females suffering with a profuse vaginal discharge which spreads over to the anus and infects it. The symptoms are slight, the discharge is not profuse and is usually overlooked. It may produce a chronic inflammation of the rectum, fibrosis and condylomata acuminata. As a rule it clears up without becoming chronic.

In the male the etiology of anorectal gonorrhea is the practice of sodomy. Condylomata develop early and they are practically always secondary to anorectal gonorrhea. The condylomata acuminata present a cauliflower growth often very large with marked infection around them making walking difficult and disabling the patient. The large condylomata require surgical removal. In the male the condition is progressive and becomes chronic. The condylomata acuminata are sometimes mistaken for the condylomata lata of syphilis. Gonorrhea

reheal stricture of the rectum may develop as a sequel of gonorrheal proctitis and is often diagnosed as of syphilitic origin

Buccal and Nasal Gonorrhea Gonorrhea of the mouth undoubtedly occurs but the cases are difficult to prove and only a few authentic cases have been described Nasal gonorrhea also has been reported Some cases of coryza in the newborn have been attributed to the gonococcus

CHAPTER 12

TREATMENT OF GONORRHEA¹

GENERAL PRINCIPLES	PYOSESICULOSIS
PERSONAL AND SEXUAL HYGIENE	EPIDIDYMITIS
INTERNAL MEDICATION	LOCAL COMPLICATIONS OF GONORRHEA
LOCAL TREATMENT	GONORRHEAL ARTHRITIS
INJECTIONS	FOCAL
IRRIGATIONS	LOCAL
INSTILLATIONS	SYSTEMIC
ROUTINE TREATMENT	TREATMENT OF SUBACUTE GONORRHEA
ACUTE GONORRHEA	CHRONIC GONORRHEA
HYPERACUTE GONORRHEA	CHRONIC ANTERIOR URETHRITIS
SUBACUTE TYPE	DETERMINATION OF THE CURE OF GONORRHEA IN
ACUTE POSTERIOR URETHRITIS	THE MALE
FOLLICULAR PROSTATITIS WITH VESICULITIS IN	A ACUTE GONORRHEA
ACUTE GONORRHEA	B CHRONIC GONORRHEA
PROSTATIC ABSCESS	

GENERAL PRINCIPLES

The means at our command for combating gonococcal urethritis and its complications still leave much to be desired

We have as yet no specific to combat the infection in the urethra or the accessory glands. Drugs that have proven their value empirically such as silver nitrate and its various combinations are still used satisfactorily. We have more to learn of the biology of the gonococcus and the reaction of the body to the infection, so that the treatment of gonorrhea is still a chapter which remains open for future workers to improve or to discover a specific. While no specific therapy is at hand our fundamental understanding of the disease has advanced markedly in the past decade.

There are, however, as the result of clinical experience and experimental studies, rational methods of treatment which if properly carried out give satisfactory results. We are not without means of combating the infection. In fact, the vast majority of cases respond successfully and are cured by the methods employed at present.

As stated previously gonorrhea is peculiar to man and none of the lower animals that have been inoculated with the gonococcus experimentally have become infected. It is evident that neither the variation in the body heat of the human from that of lower animals or variations in the structure of the mucosa, are the factors producing susceptibility in the human and immunity in the lower animals. There are evidently certain characteristics of the blood or the fluids of the body either antibodies or some undiscovered properties of the same inherent in lower animals and not present in the human thus giving immunity to animals and susceptibility to the human. The presence of seminal vesicles as hollow reservoirs for semen in man as against the seminal glands of the lower animals, which are solid secreting bodies is a distinct variation in the anatomy that may have some relation to susceptibility. It is evident that the successful specific when found will be something that will activate the blood to produce an agent that will destroy the infection wherever present.

Gonorrhea in the majority of cases runs a more or less self limited course

We are indebted to Dr. M. M. Brunet for valuable assistance in the revision of this chapter

influenced to a considerable degree by medication. A study of the anatomy and pathology in the urethra and seminal ducts will explain the difficulties encountered, the limitations of treatment, the cause of complications and chronicity. The gonococcus infiltrates deeply into the mucosa and submucosa and becomes inaccessible to local medication in the urethra. The urethral glands are tortuous (Fig 183), become occluded by the inflammation and pus, and the crypts are deep pockets harboring the gonococci. The lacunae in front of the triangular ligament open toward the meatus and those in the posterior urethra open toward the bladder (Fig 184) making direct medication difficult. The varying caliber of the urethra (Fig 46) with its dilatations at the bulb and at the fossa navicularis, favor blind pockets at these points where the gonococci are not all washed out with the urinary stream. The prostate and seminal vesicles, practically always infected in posterior infection, present additional problems. The seminal vesicles, hollow tortuous sacs with no glandular structures and with poor drainage through the rigid tortuous ejaculatory duct (Fig 47) favor chronicity and are not benefited by urethral medication, except where the ducts are patulous. The prostate is more readily accessible, is a glandular, vascular organ, can be medicated from the urethra, but is also a source for chronicity.

The seminal vesicles, as the source of the oft-complicating epididymitis, as the focus for systemic infection manifested mainly by gonorrheal rheumatism and as the cause of chronicity and recurrence, play a large part in the consideration of treatment.

In recognition of the fact that (a) we have as yet no specific treatment, that we also do not have any drug that can, when injected into the urethra, penetrate the mucosa, submucosa and glands to destroy the gonococci, and (b) the resistance of the body and the tissues locally against the infection are the main factors in combating it, the purpose of treatment is to destroy the gonococci wherever they are accessible and also promote the resistance of the body and the tissues against the infection. The aim of treatment is therefore, the alleviation of symptoms, the prevention of complications and the hastening of the cure. In the routine case the grouping of treatment under Hygiene, Local Medication and Internal Medication is very satisfactory.

PERSONAL AND SEXUAL HYGIENE

Under this heading are included all restrictions in mode of life and conduct that will enable the individual to increase and maintain the resistance of the body against the infection and the avoidance of anything that will lower the resistance or that may irritate the urethral mucosa. The patient should dress warmly, avoid draughts, exposure to cold and wet, and eat plain light food. Alcohol in any form should be forbidden until the gonorrhea has been cured. It is an irritant to the urethral mucosa and to that of the seminal duct and lowers general resistance against the infection.

Personal Hygiene The underwear is often spotted with the dried pus. It should be washed separately from that of the rest of the household or destroyed. Care in handling the penis and rubbing the eyes afterwards is important. In order to prevent the discharge from getting on the underwear a dressing, preferably

gauze should cover the penis. A special bag for the penis is most satisfactory. In wearing a bag or a dressing on the penis neither should be applied tightly. danger of producing edema of the prepuce and glans with phimosis should be considered. Rubber bands to hold the dressing should not be used. Gauze dressings are preferable to cotton because they do not adhere as much. The penis should be washed to prevent the pus becoming encrusted over the glans and the prepuce should be retracted and washed daily. Soaking the penis in hot water is an excellent procedure to reduce the swelling of the prepuce so commonly associated with an active infection. The patient should wear a scrotal suspensory or support from the beginning to lessen the venous congestion in the scrotal sac and also to lessen the incidence of epididymitis.

Sexual Excitement. Erections are often impossible to prevent but sexual excitement with prolonged erections irritates the inflamed urethra and hastens the complications. For this reason dancing may be harmful. Some men will even have coitus during the acute stage.

Limitation of exercise bathing etc. No active exercise such as handball tennis or swimming. Always warn the patient to be careful about cleaning the tub well after a bath and that he should be particularly careful if there are little girls at home. The patient should limit his activities as much as possible. He should sit down at work rather than stand if this be feasible. Long automobile trips with considerable jarring are harmful. Horseback and bicycle riding are forbidden. The patient should keep regular hours, get sufficient sleep and rest. Late hours and little sleep are harmful. Except in certain severe cases and in complications it is unnecessary to put the patient to bed in order to hasten the cures or for proper treatment. In the vast majority of cases gonorrhea produces very little systemic reaction the process is quite localized and the patient can attend to his affairs although less actively.

Diet. This should consist of foods easily digestible and non irritating. Heavy foods containing much protein such as eggs or red meats should be used sparingly as they raise the acidity of the urine and increase the pain and discomfort. White meats and fowl are preferable. Anything seasoned or highly spiced that may irritate the urethral mucosa when excreted, should be avoided. Vegetables, milk and cereals are good.

Water. A sufficient fluid intake is one of the most important adjuvants in the treatment of gonorrhea and its complications. The patient should be instructed to drink at least 8 to 10 glasses of fluid daily including milk. A cup of coffee or tea in the morning is not harmful although a large amount may be irritating to the kidney. In some cases lessening the fluid intake is necessary to give the acutely inflamed structures as much rest as possible. In severe cases of posterior urethritis with prostatocystitis or in severe acute prostatovesiculitis the amount of fluid intake should be reduced to a minimum to lessen the frequency of urination. Carbonated waters must be avoided.

Care of the Bowels and Excretion from the Skin. The patient should have regular bowel movements and if necessary resort to cathartics to prevent constipation. Hot baths two or three times per week are beneficial, to produce perspiration and elimination from the skin.

INTERNAL MEDICATION

The remedies used internally in the order of their importance are Sulfanilamide, the Balsams, urinary antiseptics and alkaline diuretics

Sulfanilamide With the advent of Sulfanilamide, internal medication, which had been of relatively minor value, has assumed a most important place in treatment. The physiologic effects and pharmacologic action of this drug are not clear. Its action is indirect. It has practically no direct bactericidal properties. Some alteration takes place in the tissues to combat the infection. This drug has proven of distinct value in various types of streptococcal infection, as well as in the treatment of gonorrhea. It does not remain in the tissues very long, and is almost entirely excreted by the kidneys. It is effective in both alkaline and acid mediums. It is difficult to establish a definite scheme of dosage, for the tolerance of each individual to this drug varies considerably. Men tolerate it better than women, and the young better than the aged. The best results are obtained with large doses, particularly the first 2 to 3 days. If no beneficial results are obtained in 7 to 10 days sulfanilamide should be discontinued. The average initial dose for the first 2 days given by the majority of urologists is 80 grains, reduced to 50 on the third day, and 15 grains thereafter. However, some give larger doses over a longer period, whereas others limit the dosage to 20 to 30 grains daily. The drug can be found in the blood and all body secretions. The untoward manifestations are anemia, cyanosis and sulf-hemoglobinemia. Neurologic disturbances in the form of headache, dizziness and lassitude are common. Skin, gastrointestinal and urinary tract disturbances may also occur. These untoward symptoms must be guarded against and treatment discontinued when they appear. Analysis of various reports show the drug to be of distinct value in shortening the duration of symptoms, and the lessening of the incidence of complications. In many cases the discharge disappears within the first few days after treatment is administered. The period of cure is definitely lessened with the use of this drug. While it is not specific for the cure of gonococcal infection it is at the present time the most valuable drug in the treatment of gonorrhea. Local treatment in conjunction with sulfanilamide gives the best results.

Balsams are those of copaiba, cubebs and sandalwood oil. They have a slight antiseptic effect and are soothing to the urethral mucosa, lessening the irritation of the urine. These and other balsams have been used for many years and have been found to be of some value. Sandalwood oil is the best, either in one of its various pharmaceutical combinations or best unmodified, administered in capsules. It is of particular value during the first ten days or two weeks of the infection but of little or no value after that. It is also of value during the subsidence of complications such as epididymitis and acute prostatovesiculitis. It should be administered in ten minim doses three or four times daily, during the first ten days or two weeks, in order to get the most desired effect.

Sandalwood oil is irritating to the stomach, produces eructation of gas and belching at times and when this is marked, the oil should be stopped. Given in large quantities it is also irritating to the kidneys. Evidence of this irritation is backache and when complained of, its administration should cease. Copaiba is also a valuable remedy, administered in capsule form. Prolonged administration

may produce a rash such as is seen in measles that may frighten the patient into the belief that it is of syphilitic nature.

The Alkaline Diuretics. These are administered to decrease the acidity of the urine and in this way lessen the irritation upon the urethral mucosa. The alkaline salts of potassium and sodium such as potassium or sodium citrate and acetate and also sodium bicarbonate, are the best. Fifteen to thirty grain doses three times a day will reduce the acidity and alkalinize the urine. The alkalies are especially indicated during the third and fourth week at the height of the infection to lessen the irritation of the inflamed prostatic urethra.

Urinary Antiseptics. There are no real urinary antiseptics. Urotropin is still the best drug we have. Methylene blue was much used formerly and may still be a valuable drug. It acts as a sedative on the axones of the peripheral nerves and is excreted by the epididymis. The action of the various antiseptics may be due to their excretion through the epididymis into the seminal duct as well as through the urinary tract. Belfield and Rolnick have shown that dyes are excreted by the body of the epididymis. The action of santal oil may be by way of the seminal duct. Urotropin is more effective in an acid medium such as sodium acid phosphate. It can be given in five grain doses, three times a day routinely. Salol and sodium salicylate are also rated as internal antiseptics.

Antispasmodics. Bromides given in twenty to thirty grain doses at bed time help to prevent painful erections. Antispasmodics are useful and often necessary to relieve the tenesmus and pain in severe posterior urethritis and prostatic vesiculitis. Belladonna and hyoscyamus are the best sedatives. Opiates given with the antispasmodics are very useful. Suppositories of opium and belladonna are commonly used and are very satisfactory. Camphor monobromate 2 to 5 grains in pill form or the mixed bromides are also useful for painful erections (chordee).

LOCAL TREATMENT

Gentleness and patience are most important in the local treatment. Do not attempt to hasten the cure but try to avoid complications. The local treatment is far more important than the internal medication and when given effectively, properly and instituted early, it is the most important means at hand for the cure of the infection. Local treatment should be instituted with the onset of the infection except in certain cases of hyperacute gonorrhea where early local treatment is contraindicated. It is impossible for any of the known local antiseptics to do more than destroy the gonococci on the surface of the urethral mucosa and penetrate a little. Their effect is to make the urethra a poor soil for the gonococci. The most important objective is to increase the resistance of the mucosa and the glands against the infection either directly or through some change in the secretion. It is well known that silver nitrate and its various derivatives are only slightly antiseptic in the test tube and in the urethra. They are however the most effective drugs we have although their mode of action has not been definitely determined. Drugs that are good bactericides elsewhere such as mercurochrome have not been shown to be of much value in the urethra. Since the resistance of the tissues locally is of the greatest importance anything which reduces this should be avoided. Injections of antiseptics of an irritating nature not only destroy the organisms but also injure the urethral mucosa. The array of drugs that have

been used in the past, and others that are still employed, as well as the new preparations on the market each year, indicate that considerable room for improvement exists in our local antiseptics and that we have no specific. However, the drugs that have proven of value empirically and have stood the test of time are still the most useful and if properly employed, give good results. They are divided into antiseptics, antiseptic astringents and ordinary astringents. The latter are not very important and should be used only after the gonococci have left the urethra.

Antiseptics Silver nitrate and its derivatives are the most useful antiseptics we have. Silver nitrate is the best antiseptic we have in urology. It acts on the urethra by liberating nitric acid and coagulating albumen and also has an indirect effect in stimulating the urethral mucosa, which is most important. Silver nitrate is quite irritating in the acute stage, but its various derivatives are less so and are most commonly employed. Silver nucleinate (argyrol) and silver proteinate (protargol) are the most useful local antiseptics in the urethra. While they are less antiseptic than is silver nitrate (silver nucleinate particularly being only slightly antiseptic), they are of value in that they are soothing and stimulating to the urethral mucosa and produce a localized leucocytosis and flow of lymph. Silver nucleinate, five to ten per cent strength, and silver proteinate, one-eighth to one-half per cent, are the dilutions employed for urethral injections. There are other silver salts which are also satisfactory.

Antiseptic Astringents Potassium permanganate, 1-4000 as a hand injection and 1-5000 to 1-10,000 for irrigation, is most commonly used. It acts directly on the gonococcus and also indirectly by causing an edema of the urethral mucosa, in this way helping to destroy the organisms.

Astringents These are little used at present because the continued use of silver proteinate and nucleinate until the discharge ceases, is preferable.

INJECTIONS

Silver proteinate and nucleinate are the drugs most commonly used as hand injections. Hand injections are the mainstay of local treatment. Injections should be given more than twice daily during the first 2 weeks, and can then be reduced to once daily.

Potassium permanganate 1-4000 is a favorite hand injection, but not as valuable, however, as the silver salts. It is quite efficacious and many clinicians recommend and employ it in 1-4000 dilution.

IRRIGATIONS

Irrigations are not as popular in this country as they have been in the past. Silver nitrate 1 to 16,000 to 1 to 10,000 and potassium permanganate 1 to 10,000 to 1 to 5,000 (the strength of the solution increasing with the duration of the process), are the two most commonly employed. Irrigations are always office treatments and must be employed regularly and routinely to be of value. The patient should be irrigated daily the first two weeks, then every second day and toward the end, one or two times a week. With the daily irrigations, the patient should also use the hand injections routinely, as described.

Irrigations are divided into two types—*anterior irrigations* for irrigating the

anterior urethra and posterior irrigations for irrigating the posterior urethra also (Figs 103 and 104)

Anterior irrigations are best given with the gravity method and posterior irrigations with a catheter in the urethra (Fig 104) and a large hand or bulb syringe. (Fig 87) The value of the irrigations is that they distend the urethra and in this manner medicate all of it. They may possibly act indirectly because the distension causes a hyperemia—acting in the form of massage

The complete filling up of the urethra with a hand injection also acts in the same manner. Weak solutions of bichloride and oxycyanide of mercury are also used for irrigation also acroflavin 1:5000

INSTALLATIONS

These are usually given in involvement of the deeper structures but may also be employed for medicating the anterior urethra. A small Keyes-Ultzmann catheter and syringe or a Guyon instillator (Fig 106) may be used. Silver nucleinate ten to twenty per cent, is the best drug for instillation. It is the best drug for the treatment of the posterior urethra and silver proteinate is best for the anterior urethra as hand injections. Mercurochrome is of distinct value in certain cases of cystitis of non-gonorrheal origin. Silver nitrate is the mainstay for instillation in chronic urethritis and also following instrumentation

ROUTINE TREATMENT

ACUTE GONORRHEA

Cases present individual variations that require long experience as a guide. The treatment should be governed by the clinical course and by the microscopical examination of the discharge and the shreds. The appearance of the shreds, their character, the amount of pus in the urine and where located (as determined by the glass tests and rectal examination) are guides to follow. It is probably even more important to know what not to do than to know the routine of treatment. In general, conservatism is the wisest course. It is almost unnecessary to repeat that the patient should always urinate before injection or instrumentation. The latter is contraindicated in the presence of an acute inflammation of the urethra. Do not massage the prostate or vesicles during the acute stage. The patient should be seen daily during the first ten days or two weeks, later every other day and then two or three times a week. Examination of the discharge, the penis and urethra and particularly the meatus and a routine two-glass test (Fig 190) are necessary before each treatment. The physician should not treat gonorrhea if he is afraid to palpate or examine thoroughly. Asking the patient how he feels and making a two-glass test is not sufficient. The color of the discharge, its profuseness and particularly the microscopical examination are important guides. The last named should be done routinely at least twice a week. After the diagnosis has been established a methylene blue stain is sufficient. The value of microscopical examination is not only to determine the presence of gonococci, their relation to the pus cells, whether extra or intra-cellular (Plate III) but also for other reasons. One can determine by the microscope the progress of the case. The presence of epithelium and some mucus indicates a decline of severity of the process and evidence of healing.

Vaccines and Foreign Proteins These constitute a valuable adjuvant therapy during the course of chronic gonorrhea, as well as for some of its local complications, and systemic infection. In complications such as epididymitis, the intravenous injection of gonococcus mixed vaccine produces a severe reaction which affects the course quite favorably. This treatment should only be given to patients confined to bed. In gonorrheal arthritis they may offer valuable help in combating the systemic infection. Although vaccine and foreign protein therapy have fallen into some disrepute, they are distinct aids in the subacute and chronic stages. Foreign proteins most commonly employed are milk or its preparations.

Autohemotherapy The removal of a few cubic centimeters of blood from the patient and the injection of the same into his buttock has been employed but with very little success.

Sodium iodide intravenously, aids resorption in acute epididymitis and is often of value in subacute and chronic prostatovesiculitis. Calcium chloride and calcium gluconate intravenously, while having no effect on the course of the infection, gives remarkable relief from pain in acute epididymitis.

Diathermy Diathermy has proven to be of practically no value in acute gonorrhea. Electrodes placed in the urethra are dangerous because of the trauma and of the resulting extension of the infection. In chronic prostatovesiculitis, medical diathermy per rectum has often helped when prolonged massage has failed to benefit. For the relief of the pain and the hastening of the subsidence of the infection in acute epididymitis, diathermy is distinctly beneficial. However, it is questionable whether it should be used, because the great heat produced within the scrotum may destroy permanently or temporarily, the spermatogenic function of the testicle.

Light Therapy Ultra-violet and quartz lamp therapy for acute epididymitis and chronic prostatovesiculitis has helped in some cases.

Rectal irrigations for subacute and chronic prostatovesiculitis is a method not used as much now as formerly, but helps in some cases.

Rectal Suppositories Suppositories of belladonna and opium are of great aid in relieving the tenesmus in acute prostatovesiculitis.

Hydrotherapy and Thermotherapy Hot sitz baths and hot towels and pads or bags to the perineum are of much value in acute prostatovesiculitis or a beginning prostatic abscess. Hot baths twice a week during the course of an acute gonorrhea to promote elimination through the skin are beneficial. Soaking the penis in hot water in the presence of edema of the prepuce and glans and application of heat to an inguinal adenopathy, is of distinct value.

Hyperpyrexia The elevation of body temperature over a period of hours by the artificial production of fever has proven to be of considerable value in selected patients and in the treatment of complications, particularly arthritis. The method in use at present is exemplified by the Kittering Hypertherm. This fever cabinet is large, covering the whole body with only the head exposed. The temperature is gradually brought up to 105 to 107 degrees in 1½ to 2 hours, and maintained at this level for 4 to 8 hours or longer. It is evident that the time consumed in the treatment of the individual patient will not permit the method to become popular. This treatment is also not free from danger, deaths have been reported. It should be employed with caution, requiring constant care of an attendant, nurse and physician. Some excellent results have been reported. Pelvic

infection in the female and arthritis have responded rapidly to treatment. When employed in the young and vigorous patient early in acute gonorrhea, rapid cures have been reported, but in the main the results have not been satisfactory. The fever therapy must often be repeated five to six times with an interval of three to four days between each treatment. Very little is gained in the uncomplicated case by the use of this therapy.

Urethroscopy endoscopy Since the urethral glands are almost microscopic in size and are tortuous, it is practically impossible to treat them directly through the endoscope with strong caustics such as silver nitrate or with an electrode. The lacunae behind the triangular ligament open toward the bladder (Fig. 184) and it is impossible to reach their orifices. Some cases of urethritis may be benefited by direct medication through the endoscope. Touching up the verumontanum or cauterizing it in chronic prostatovesiculitis is mentioned to be condemned. One gains nothing in cauterizing the veru when the pathology is in the prostate and vesicles and in doing so may seal the ejaculatory ducts aggravating the infection in the vesicles and adding the danger of an epididymitis.

Vasotomy This is a procedure first recommended by Belfield in 1904 and is valuable in some cases of infections of the seminal vesicles. It will be discussed more fully in succeeding chapters.

Surgery in Gonorrhea Epididymotomy is sometimes indicated for acute epididymitis that does not clear up within the usual period of time or in continued recurrent attacks after the infection has apparently subsided. The procedure may be either intra or extravaginal depending upon the part of the epididymis to be incised. Phimosis in acute gonorrhea occasionally requires a dorsal slit. Meantotomy is often necessary in the treatment of chronic urethritis preliminary to the use of a sound. Prostatotomy for prostatic abscess is rarely indicated but an incision of a peri urethral abscess is sometimes necessary.

Summary of the Routine Treatment of Acute Gonorrhea. We do not classify acute gonorrhea as acute anterior urethritis only and consider the extension of the infection necessarily as complications. Acute gonorrhea in the vast majority of cases, consists of involvement of the anterior and posterior urethra with a mild degree of prostatovesiculitis and it therefore should be treated as an entity from this standpoint.

All of the injunctions covered under Hygiene should be followed carefully. It is unnecessary and also unwise to put the average patient to bed. His vitality is lowered and his thoughts are too much centered upon his disease if he is made an invalid unnecessarily and above all the course of the disease is not hastened materially. The suspensory may be discarded in the last two weeks and absolute abstinence from alcohol and coitus should be observed until after the condition is completely cured.

Ten minims of sandalwood oil three times daily for the first ten days or two weeks, after which the alkaline diuretics such as potassium citrate or acetate fifteen grains, three times daily or urotropin five grains three times daily for the next three or four weeks, constitute the internal medication.

Injections should be given as soon as the discharge appears. Silver Nucleinate 10 per cent, by the physician on the first day of the discharge this to be repeated daily for the first 10 days or two weeks. The patient should use a hand injection of silver proteinate one-eighth per cent the first week one fourth per cent the second

and third weeks, and following this one-half per cent, until the end. Inject one to two times daily during the first week, during the second and third weeks inject once daily. A one-half ounce syringe should be used. If irrigations are given they should be administered daily for the first two weeks, then every other day, later two to three times a week until the end. Permanganate of potassium 1 to 5,000 is the best standard solution for irrigation. Hot sitz baths, regular evacuation of the bowels, and some heat to the perineum, will take care of the associated prostatovesiculitis in the average case. Massage is contra-indicated in an acute case.

HYPERACUTE GONORRHEA

No local treatment should be instituted until the marked edema and inflammatory reaction have subsided. Internal medication only, should be given at the start and vaccines are preferably dispensed with. When the swelling has subsided, local treatment is instituted. In some cases of severe acute gonorrhea with only a moderate degree of swelling of the glans, local treatment can be instituted from the start with decided benefit to the patient. Rest in bed is of great benefit for the first few days until the hyperacute infection subsides.

SUBACUTE TYPE OF ACUTE GONORRHEA

The urethra must be stimulated to promote a reaction against the infection. One-sixteenth to one-tenth per cent silver nitrate should be injected once daily for two or three days at the onset, then when the reaction has occurred with slight increase of the discharge and redness, routine treatment is instituted. Vaccines are of particular value here.

A mild degree of posterior urethritis with the second glass (Fig 190) cloudy, and an absence of nocturia or only once a night, can be disregarded as requiring special local treatment. The posterior urethra need not be medicated, because the infection will clear up with ordinary hand injections of the anterior urethra.

ACUTE POSTERIOR URETHRITIS

Prostatocystitis with terminal hematuria should be treated as follows. The patient should be put to bed and all local treatment discontinued, belladonna and opium should be given internally and by suppository. Fluid intake should be limited. These measures will clear up practically all cases of terminal hematuria within a few days. Sandal oil internally at this time, is of considerable value. Mild catarrhal prostatitis and vesiculitis should be treated with the ordinary care of the anterior urethra. Hot sitz baths two or three times per week are of help and proper elimination from the bowels, thus producing hyperemia and relieving congestion in the perineum. Do not massage the prostate or vesicles in the acute stage.

FOLLICULAR PROSTATITIS WITH VESICULITIS IN ACUTE GONORRHEA

This may involve one or both lobes of the prostate and give rise to symptoms of congestion in the perineum, some tenesmus and urgency. The patient should have as little activity as possible and a few days rest is preferable. Hot sitz baths, together with heat to the perineum in the form of electric pads or hot water bags, suppositories of opium and belladonna and limited fluid intake will help tide over the acute stage. When diffuse parenchymatous prostatitis develops, the patient must be put to bed and given one or two hot sitz baths daily, together with con-

tinuous heat to the perineum. Rectal irrigations are also of value. Internal medication to reduce the fever and also antispasmodics for urinary distress, are indicated. In parenchymatous and follicular prostatitis all local medication by way of the urethra should cease. Proper bowel evacuation is important. The condition usually responds to treatment.

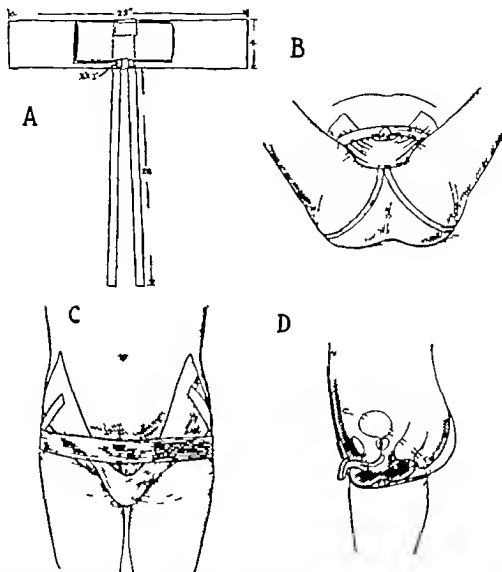


FIG. 192.—Adhesive plaster scrotal suspensory devised on the Urological Service of Bellevue Hospital. (Courtesy of Dr. M. F. Campbell.)

A. Dimensions of adhesive plaster to be placed so that it will fit high in the scrotoperineal angle with aid of a roller bandage (2.5 by 1 inch) the object being to give support to the scrotal contents and to prevent these from slipping downwards. With this roller bandage high in the perineoscrotal angle, the lower straps are brought around through the gluteal folds over the hips (see B) and the broad strap which really gives the suspension is brought up over the iliac crests (see C) thus holding the testicles high with firm support and complete immobilization. An additional cross-trap suprapubically reinforces the dressing (see D).

D Shows how this dressing supports the Scrotum.

PROSTATIC ABSCESS

It is usually necessary to catheterize to relieve the frequently associated acute urinary retention. However this complication is seldom encountered. With evidence on rectal palpation of fluctuation the abscess should be opened through the perineum preferably (see Chapter 49) on each side of the median line. It may sometimes be wise to wait until the abscess ruptures spontaneously through

the urethra, but it is far better to resort to surgery than to wait for this. Mild forms of acute seminal vesiculitis in association with prostatitis clear up under routine treatment for posterior urethritis, by injections and irrigation. The more severe types of vesiculitis, with hemo- and pyospermia, associated with prostatitis, require the same treatment as for prostatitis viz, heat to the suprapubic region and perineum, hot sitz baths daily, proper elimination through the bowel, plenty of fluids and internal antispasmodics, such as opium and belladonna. If the condition does not respond rapidly, vasotomy is definitely indicated at once, in these cases.

PYOVESICULOSIS

This term is employed by Belfield and Rolnick to indicate a closed pus sac of the seminal vesicles analogous to a pyosalpinx. The term Empyema of the seminal vesicle can also be used. This may produce acute urinary retention, compress the ureters and result in oliguria (see Chapter 47) and even complete anuria. Rest in bed and hot applications may reduce the edema of the ejaculatory ducts or dislodge the plugs of pus in the ducts and this may be followed by the sudden emptying of the distended seminal vesicles often diagnosed as a rupture of a supposed prostatic abscess. If no relief is obtained in a few days, vasotomy is indicated here also.

EPIDIDYMITIS

Premonitory symptoms such as pressure in the inguinal region and dull ache along the vas deferens, appearing twenty-four hours before onset of the swelling, are an indication for immediate vasotomy in order to prevent the possibility of an epididymitis. There is usually a slight infection of the epididymis present at this time and vasotomy will prevent further development of the epididymitis except that of a slight involvement of the tail. Typical acute epididymitis with fever requires rest in bed until the fever has subsided and acute local inflammation has receded. Support of the scrotum with towel or bandage (Fig 192), external heat, in the form of hot bags, towels or electric pad, is indicated. Antipyretics such as sodium salicylate or aspirin are good. Local applications of a saturated solution of magnesium sulphate or ten per cent Ichthyol ointment, are also of some value. The value of foreign proteins has been mentioned, also the intravenous medication with calcium chloride and gluconate every other day for the relief of pain during the acute stage, and sodium iodide, for absorption of the exudate. Sandal oil internally is of some value during the acute stage. Diathermy also hastens resolution of the process and relieves pain. Severe cases of epididymitis with involvement of all of the contents of the scrotum and a funiculitis, often require the internal administration of opiates to relieve the pain and distress. All of the other treatments above mentioned should also be instituted. Epididymotomy is indicated when the infection does not subside in 3 to 4 weeks, or if after apparently subsiding, again flares up. A vasotomy should always be done at the same time. Without a vasotomy, an epididymotomy is like "mopping the floor without turning off the faucet" (Belfield).

Following the subsidence of an epididymitis, a hydrocele containing 2 to 30 cc is often present. This can be aspirated, but usually resolves without treatment.

Occasionally an abscess will develop in the scrotum secondarily, or a funicular abscess may develop. This requires incision and drainage. All local urethral treat-

ment should cease during the acute involvement of the epididymis and there should be no massage of the prostate and vesicles during this period. Local treatment of the urethra must not be resumed until the 2nd urine has been clear for 10 to 14 days. It is well to remember that after the clearing up of the epididymitis the patient still has his vesiculitis which requires further treatment over a considerable period. Recurrent epididymitis is a definite indication for vasotomy. The infection in the vesicle has remained dormant and may flare up, giving rise to another attack unless the seminal vesicle is sterilized.

LOCAL COMPLICATIONS OF GONORRHEA

Local complications are inguinal adenitis, edema of the prepuce, phimosis, peniurethral abscess, Cowperitis.

Edema of Prepuce. More common in some than in others and the brawny swelling at the frenulum often persists. Hot applications soaking the penis in warm water hastens the subsidence of the edema.

Phimosis and Para phimosis. These complications are uncommon. Occasionally a dorsal slit is necessary to relieve the tension on the urethra and glans in para-phimosis.

Peniurethral Abscess at Frenulum. When this occurs and fluctuation appears, it is best to incise at once in order to prevent the formation of a permanent fistula.

Inguinal Lymph Node Infection. This is a painful enlargement of the inguinal lymph nodes and is usually unilateral. It clears up in a few days with heat in the form of hot baths and local application of hot water bag or hot towels. Iodine painted over this region reduces the swelling rapidly.

GONORRHEAL ARTHRITIS

The treatment of gonorrheal arthritis and of gonococcus sepsis and metastatic infections such as iritis and skin complications can be classified as focal, local and systemic.

1 FOCAL

The foci for the systemic infection in gonorrheal rheumatism are in the prostate and seminal vesicles. Whereas local treatment to the involved joint and intravenous medication, will help the local and systemic manifestations, there will be recurrences and repeated flaring up and chronicity in most cases, unless the foci in the prostate and vesicles which harbor the gonococci for a long time are eliminated. The seminal vesicles are the particular source of the systemic infection. Massage of the prostate and vesicles over a period of many weeks or months will clear up many of the cases of associated prostatovesiculitis and cure the gonorrheal arthritis, but in many cases, massage for months and years will have very little effect on the rheumatic manifestations. Many men suffering with chronic arthritis of the feet, ankles and knees have had thorough massage from the beginning with out much benefit and the chronic changes have developed in spite of the treatment. The discharge at the meatus (with gonococci often present) should be treated with band injections. In very stubborn and protracted cases vasotomy should be done.

PLATE VI

SHREDS AND FORMATIONS PASSED IN THE FIRST URINE WITHOUT MASSAGE

FIG 1—Numerous fine shreds of different sizes, principally from the anterior urethra, in cases of chronic urethritis in the process of healing

FIG 2—Numerous small fine shreds and a few large thick pieces, coming principally from the posterior urethra. The small comma-shaped shreds are most common in this part of the canal. The thick pieces at the bottom come from irregularities, depressions and pockets in the prostatic urethra, due generally to former prostatic abscesses. They are most abundant after massage.

FIG 3—Thick, lumpy shreds, resembling very coarse meal, in cases of chronic urethritis, and coming principally from the bulbous and posterior portion of the canal in chronic urethritis.

FIG 4—Long slender shreds, supposed to come from the ejaculatory ducts, in chronic urethritis.

FIG 5—Floating masses of semen, nearly all prostatic fluid passed with the first urine. They are seen often in cases of prostatorrhea and catarrhal prostatitis, and also when there are no symptoms of genito-urinary trouble and the patient is passing normal urine. (Guiteras' Urology, Courtesy D. Appleton Co.)

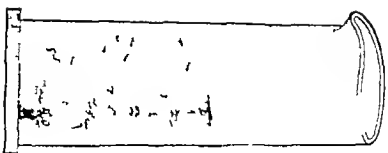


FIG. 1

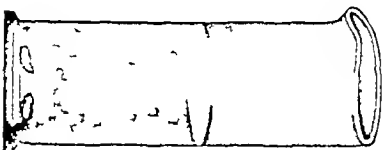


FIG. 2

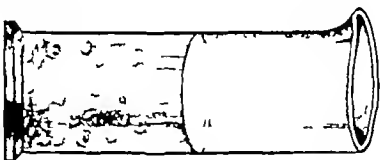


FIG. 3

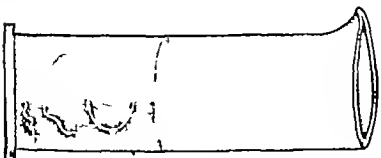


FIG. 4



FIG. 5

PLATE VII

FORMATIONS COMING FROM THE VESICLES AFTER MASSAGE

- FIG 1 —Large amount of detritus, light in texture, resembling snowflakes, coming from the vesicles with elastic walls In the bottom a lump is seen which represents the casts of both vesicles
- FIG 2 —Formations in the urine resembling pieces of membrane or skin, coming from the wall of atonic inelastic vesicles in chronic vesiculitis
- FIG 3 —Formations resembling tapioca, coming from vesicles with fairly elastic walls in chronic vesiculitis They are not frequently seen
- FIG 4 —Formations resembling small sago bodies, coming from the vesicles in chronic vesiculitis of a milder type
- FIG 5 —Formations resembling sugar granules, coming from very mild cases of chronic vesiculitis (Guiteras' Urology, Courtesy D Appleton Co)

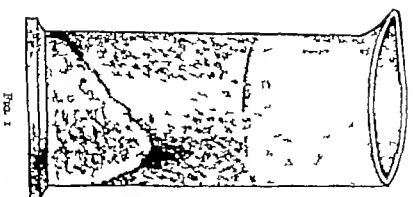


FIG. 1

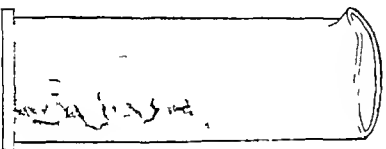


FIG. 2

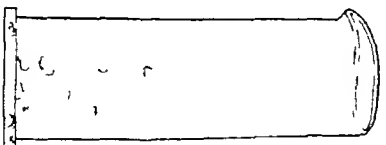


FIG. 3

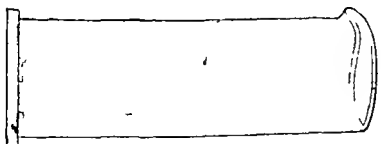


FIG. 4

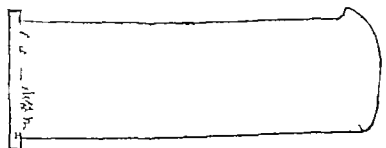


FIG. 5

a cure. Urethroscopic findings are of little positive or negative value except in some cases of chronic gonorrhea.

10 CULTURE OF SECRETIONS This is a procedure which requires a well equipped laboratory. The culture of the semen, the expressed secretions from the prostate and vesicles and the morning urine may aid in some cases. The negative clinical findings by the routine tests and microscopical examinations of discharges and secretions particularly that of the semen are the basis for determining cure. While cultures may be of value they are too often of no help and do not prove practicable in every day practice.

The patient should be under observation at intervals for the next two months after complete cure in order to determine any possible recurrence of the discharge or the reappearance of any gonococci that may have been latent. Marriage should be interdicted for six months to a year after an attack of gonorrhea and in those cases where, for various reasons, delay is impossible the use of a condom for the first year of married life is necessary to prevent any possibility of transmission of the infection.

B CHRONIC GONORRHEA

The determination of cure of a chronic gonorrhea is much more difficult than that of the acute. The gonococci may still persist in the glands (Fig 183) and crypts (Fig 182) and the deeper structures (Figs 50 and 185) (the prostate and vesicles) after apparent cure only to have the discharge reappear in a few months. Also the chronic infection in the deeper structures and the urethra may give place to the secondary organisms which are practically always associated in chronic gonorrhea, and the discharge continues. A chronic prostatovesiculitis usually catarrhal and a chronic anterior urethritis may be the sequelae and it may be difficult to determine when the gonococcal infection has been eliminated and when the purely catarrhal and non-gonococcal infection alone is present. The particular predilection of the gonococci for the seminal vesicles which is the most frequent source of chronicity brings these structures to the front in the attack against chronic gonorrhea. The eradication of gonorrhea from the community as well as from man, will be accomplished largely through the eradication of the gonococci from the seminal vesicles (Fig 50). The prostate as has been stated before is a vascular organ, a glandular structure (Fig 57) and can be medicated somewhat by way of the urethra so that the prostatic urethra is irrigated every time the patient urinates. Despite the general belief that the prostate is the chief source of chronicity, infection here is much more readily controlled by treatment than is infection in the seminal vesicles.

All the procedures mentioned in the diagnosis of the cure of acute gonorrhea should be followed. Repeated examinations of the emitted semen is most important. The presence in the semen of five or six pus cells, with or without gonococci in the one-sixth power field should still be considered suspicious. Culture of the semen is of value in these cases. The finding of motile sperm which are usually dead in an active infection of the vesicles is of value. The sperm are however often very active even in the presence of considerable pus.

Folliculitis and peri urethral abscess (Fig 188) in the anterior urethra are often the source of chronicity. The passage of sounds, massage over the sound and the injection of one per cent silver nitrate will usually bring out the gonococci.

if present The gonococci may be harbored in and about a stricture, so that dilatation of a stricture will bring them to the surface

With the persistence of a discharge, even though it be mucopurulent (for mucus alone in the discharge is not common) the possibility of the presence of gonococci must still be considered However, with the assurance that the deeper structures (prostate, vesicles and posterior urethra) have been cleaned up, and this is sometimes difficult to determine, the persistence of a discharge after one year usually means that the gonococci have disappeared and that secondary organisms such as the Staphylococci, have taken their place

Relapses, if they appear, usually present themselves within the first year after apparent cure, so that in the vast majority of cases, even with the persistence of a slight catarrhal discharge, after all tests and findings show that gonococci have been absent for a year, the patient can be safely permitted to marry

CHAPTER 13

STRICTURE OF THE URETHRA¹

TYPES OF STRICTURE

PATHOLOGY OF STRICTURE

LOCATION OF STRICTURE

SYMPTOMS OF STRICTURE

COMPLICATIONS OF STRICTURE

CLINICAL COURSE OF URETHRAL STRICTURE

DIAGNOSIS OF STRICTURE

BY INSTRUMENTAL EXAMINATION

BY MEANS OF CLINICAL FINDINGS

PROGNOSIS

TREATMENT OF STRICTURE

GENERAL CONSIDERATIONS

INSTRUMENTS

THE DILATATION OF A STRICTURE

TREATMENT OF ACUTE URINARY RETENTION DUE TO STRICTURE

COMPLICATIONS OF STRICTURE

URINARY EXTRAVASATION

CHRONIC URINARY EXTRAVASATION

Stricture of the urethra is an abnormal constriction or loss of distensibility of that channel (Keyes). The vast majority over ninety per cent are a sequel of gonorrhea. They produce symptoms due to interference with the emptying of the bladder and also as the result of the infiltration and destruction of the urethra at the point of stricture and about it.

Occurrence. Stricture of the urethra is much less common now than in the past. We have noted a sharp decline in the number of patients with urethral stricture admitted to the wards of the Cook County Hospital during the past 10 years and particularly so within the past 4 to 5 years. The old books on Urology devoted considerable space to this subject. It is still important but is now relegated to a lesser role in urinary tract pathology. The reason for this reduction in the incidence of urethral stricture can be found in the more intelligent care of gonorrhea that has been carried out within the past 10 to 15 years. Local treatment is now very mild non irritating and is also now pursued as vigorously as in the past.

Classification. Although strictures of wide caliber were described and emphasized in the past by Otis and his followers we classify an abnormal narrowing of the urethra as one that will impede the passage of a No. 26 French sound (Fig. 77). Oberlander's classification may well be followed.

1. **INFILTRATIONS OF THE FIRST DEGREE** do not impede the passage of a No. 26 sound. These are really infiltrations of a chronic anterior urethritis and rarely contract later to produce a stricture.

2. **INFILTRATIONS OF THE SECOND DEGREE** are those which will impede and grasp a No. 26 sound are arrested by the stricture but permit the sound or bulbous bougie (Fig. 82) to pass.

3. **INFILTRATIONS OF THE THIRD DEGREE** will not admit the passage of a No. 26 sound.

The urethra is not evenly calibrated (Fig. 46) and it varies in size with different individuals so that one cannot always hold fast to this classification. There are in some cases bands of infiltration in a wide part of the urethra as in the fossa navicularis (Fig. 181) which can be classified as stricture but will still permit the passage of a No. 26 or No. 28 sound with ease. Treated cases may fail to prevent narrowing except to larger calibered sounds. Aside from organic strictures

¹ We are indebted particularly to the work of Keyes and Oberlander in the preparation of this chapter.

tures secondary to gonorrhea, there are a number of other types and etiologic factors

TYPES OF STRICTURE

1 **Congenital Stricture** These are most commonly met with at the meatus in the form of a narrow, thin band of tissue on the dorsal aspect which can be readily torn or separated. Congenital narrowings at other points in the urethra undoubtedly occur but are rarely recognized unless very marked. A marked narrowing or a pin-point meatus which interferes with urination cannot be classified as stricture. Congenital valves² or bands in the posterior urethra, usually attached to the verumontanum have been recognized and a large number have been reported recently by Bugbee, Young, Wilckens and others. Complete atresia of portions of the urethra has been noted in the stillborn and in those who have died a few days after birth, without having voided.

2 **Acute Inflammatory Stricture** This is not a true stricture but is often classified under this heading. During the course of an acute gonorrhea, the edematous infiltrated urethral mucosa narrows the lumen of the urethra so that there is very little force to the stream, the urine coming out in a spray and dribbling. The same condition but more markedly aggravated, will result immediately after the injection of strong chemicals in attempting to abort gonorrhea. Injections of lysol, tincture of iodine, and bichlorid of mercury have been reported, with marked edema of the urethral mucosa and in some cases even followed by acute retention. As a sequel to this, the entire urethra may slough out and a diffuse fibrous stricture of the urethra remain as an end result. The edema of the prostatic urethral mucosa in urinary retention, in prostatic hypertrophy and in prostatic abscess, can hardly be placed in this category.

Associated with an organic gonorrheal stricture, there may develop an edema and superimposed inflammation which will still further narrow the caliber of the urethra or occlude it entirely. In practically all cases, acute urinary retention in strictures of small caliber is due to the acute edema, superimposed inflammation and spasm and not due to the stricture alone.

3 **Spasmodic Stricture** This is also not a true stricture. A spasm of the bladder sphincters may be secondary to irritation from a phimosis or a foreign body in the urethra. Hysterical patients will sometimes develop an acute retention for over twenty-four hours, due to spasm. In most cases, the spasm of the sphincters will prevent the passage of a sound temporarily, but will be relieved in a few minutes with the sound in place, by the relaxation of the sphincters. Occasionally, this spasm is of the entire urethra, so that a sound in place, will be expelled from the urethra by this involuntary spasm.

The most important spasmodic stricture is that associated with or superimposed on a stricture (Fig 193) of the bulbomembranous urethra. In some cases, it may be difficult to determine to what degree, the obstruction in an organic stricture is due to the associated spasm and occasionally this cannot be determined until the patient is anesthetized. When acute retention occurs as the result of organic stricture of the bulbomembranous urethra there is usually an associated

² See Chapter 46

spasm of the bladder sphincter, with edema and involvement of the prostatic urethra

4 **Traumatic Stricture.** Traumatic strictures are the result of tears or rupture (See Chapter XVII on Penis and Urethra) of the urethra, or follow operative

FIG. 193

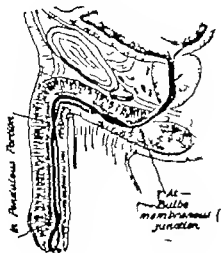


FIG. 194

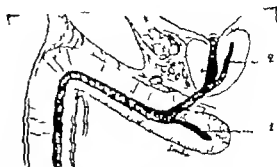


FIG. 195

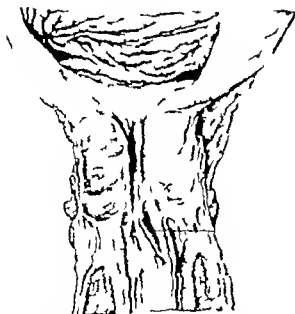


FIG. 193—Most common locations of strictures in the male urethra. (After Papin.)

FIG. 194—The upper illustration shows more frequent locations of false passages (see text) in urethral strictures. (After Papin.) 1 Into bulb 2 Into prostate.

The lower illustration taken from Legueu's Urology shows a probe inserted into such a false passage in urethral stricture.

FIG. 195—Drawing made from autopsy specimen in a case of widespread periurethral infection following rupture of the bulbomembranous urethra (site indicated by line) complicating a stricture (Courtesy of Prof. Felix Legueu of Paris.)

procedures. Gonorrheal strictures do not involve the prostatic urethra, because of the few glands and follicles present which allow the infection to persist here because the vascularity of this portion of the urethra favors the rapid absorption of any exudate and finally, because secretions are not retained here. The prostatic urethra may become very narrow and quite tortuous following either suprapubic

or perineal prostatectomy. Frequent passage of sounds is necessary in many of these cases until the urethra remains well dilated. Stricture of the prostatic urethra may also follow trans-urethral electro-resection. However, the most potent cause for the development of a traumatic stricture following trans-urethral electro-resection is that the large calibered instruments which are employed often cause considerable trauma to the urethra with tearing, and this is later followed by the development of stricture. External urethrotomy may superimpose a traumatic stricture on an already existing gonorrheal stricture. If the urethra is not frequently dilated following the urethrotomy the patient will be worse off as a result of the operation.

Fractures of the pelvic bones will result in traumatic stricture. This is not uncommon. These patients require dilatation over a period of years.

Improper and forceful passage of sounds and false passages (Fig 194) will produce enough trauma to superimpose a traumatic stricture on an already existent organic stricture.

5 Tuberculosis, Syphilis and Other Ulcerations Tuberculosis of the urethra secondary to involvement of the bladder or the structures at the bladder neck (prostate and vesicles), may produce marked ulceration and stricture. Tuberculous strictures of the urethra are not rare. Syphilis may in rare cases also cause stricture at the bladder neck or in the urethra.

6 Contractures of the Bladder Neck These are not classified under strictures and are discussed in Chapter 18. Some are undoubtedly due to gonorrhea.

7 Gonorrheal Stricture of the Urethra The intensity of the involvement, rather than its duration, is the most potent cause for this type of stricture. The gonococci may be harbored in and about the fossa navicularis and the bulb, the two points of dilatation of the urethra (Fig 46) which are cesspools for gonococci and pus, particularly so the bulbous urethra. These areas are not well washed out during urination or not medicated with injections or irrigations unless the urethra be completely distended. Strictures are most commonly found (Fig 193) at the bulbomembranous junction and in the first two inches of the penile urethra (Fig 193). The prostatic urethra is only rarely a location for gonorrheal stricture, its great vascularity permitting the absorption of any exudate without the formation of a scar.

Mild subacute gonorrhea rarely results in stricture, whereas the severe and hyperacute types produce considerable destruction and resultant scarring (Fig 193). A chronic anterior urethritis with some infiltration in the wall of the urethra, practically never develops into a stricture, no matter how prolonged the infection. Over-treatment with irritating injections and lack of local treatment or insufficient treatment, permitting the inflammation to continue, are predisposing factors. As stated previously, traumatism from instrumentation will also aid in the production of a scar.

PATHOLOGY OF STRICTURE

Gonorrheal stricture is only a cicatrization of the pathologic process that causes chronic anterior urethritis. In chronic anterior urethritis, the glands continue to suppurate because of bad drainage, their ducts being obstructed by inflammatory exudates in the urethral wall. The inflammatory periadenitis varies

in extent and intensity from that of a mere swelling of the mucosa to that of involvement of the submucosa and corpus spongiosum. The mildest form of involvement produces a slight scar with only a slight contraction of the urethra. The more extensive and intensive processes result in grave stricture, periurethral abscess (Fig 188) and fistula.

With the cicatrization of the periurethral exudate a scar is formed containing a large proportion of elastic fibers, which tends to contract and diminish the lumen (Fig 199) of the urethra. During the first six months, the stricture is vascular; the infiltrated areas appear red and it contains a greater number of elastic fibers. This is the soft infiltration of Oberlander. Later a true fibrous scar is formed which is not elastic—this is the hard infiltration of Oberlander or true stricture.

At first, the actual encroachment upon the urethral lumen is slight but the physiologic impairment is due in the main, to the infiltration of the wall, its

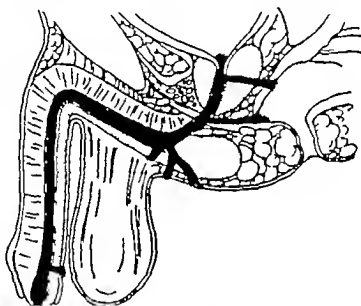


FIG. 196.—Diagram of most frequent locations of urethral fistulae. (After Papin.)

resultant rigidity and loss of elasticity. The urinary stream meets an obstacle in this rigid portion which continues to harbor gonococci and other bacteria in its inflamed glands and its surface is eroded or ulcerated. Often calcareous plaques are formed over the strictured area.

Repeated impact of the urinary stream against the stricture tends to dilate the urethra behind it and to intensify the chronic urethritis about it. As a result, more periglandular exudate is formed; more scar results, the urethral lumen is still further narrowed and the chronic urethritis persists. Periurethritis, periurethral phlegmon (Fig 195) abscess and fistula are common results of neglected stricture. Urinary sepsis due to retention and infection of the upper urinary tract results from stricture just as it does from bladder neck obstructions. The bladder muscle becomes hypertrophied and the kidneys suffer considerable damage if the obstruction and infection are prolonged. Urinary extravasation is a serious and often fatal complication.

Post mortem examination of a urethral stricture may reveal only a slight transverse scar in the mucosa. The surface of the mucosa may look normal. It

may be eroded, granulating, pouched, from back pressure or utterly distorted by irregular masses of scar and areas of suppuration

Single Stricture In the majority of cases, strictures are pathologically single (Fig 195), though they may be multiple, clinically There is but a single scar affecting a greater or lesser extent of the urethra, upon the surface of which there may be one or more ridges (Fig 198) presenting points of obstruction to the examining instruments The scar of the stricture in the penile urethra is built up chiefly from the floor of the urethra and its orifice is excentrically (Fig 199) placed near the roof

The opposite is often the case in the bulbous urethra



FIG 197—A perineum that has been operated upon for fistula several times and one opening that still exists (Guiteras' Urology, D Appleton Co, New York) See also Fig 229

Multiple strictures (Fig 198) usually become progressively narrower as they approach the bulb and the tightest point is likely to be the deepest However, if the stricture in the anterior urethra is very narrow there are seldom any others back of it

LOCATION OF STRICTURE

Thompson divides the urethra for the location of stricture into three portions

1 The bulbomembranous junction one inch in front and three-quarters of an inch behind the junction of the spongy with the membranous urethra (Fig 46) This region contains the majority of strictures They lie rather in front, than behind, the junction of the bulb with the membranous urethra

2 From the anterior limit of the bulbomembranous urethra to within two and one-half inches from the external meatus

3 The terminal two and one-half inches of the canal

SYMPTOMS OF STRICTURE

The symptoms of stricture often bear no relation to the extent of the pathologic process Some tight strictures may present very few symptoms and are

manifested mainly by a discharge at the meatus while others may show marked interference with the stream. Various degrees of retention may occur with only one narrow tight band in the posterior urethra. Most of the strictures develop during the first year after the onset of a gonorrhea. They may, however, develop as late as ten to fifteen years after the initial infection.

(a) **Chronic Urethral Discharge.** Cleet is the most common associated symptom and is due to inflammation about the stricture and the associated urethritis—a few large shreds may be present the discharge being mostly catarrhal.

The discharge—usually in the morning—is merely an evidence of inflammation and irritation and is not diagnostic of stricture.

(b) **Character of the Stream.** Although the character of the stream, its irregularity and lack of force does not necessarily indicate a stricture, one finds that in the tighter strictures, the stream is usually narrow, comes out with little force, the urinary act being prolonged and with some dribbling after it is completed. However, one finds tortuous strictures (Fig

FIG 198

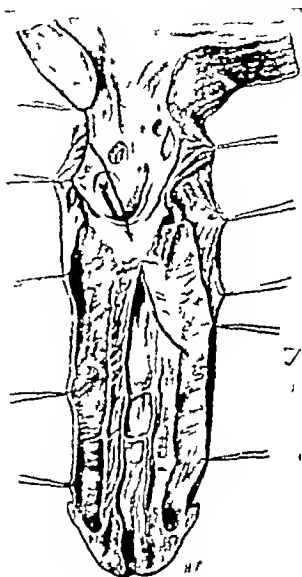


FIG. 199

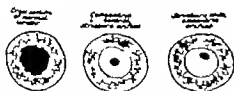


FIG. 198—Autopsy specimen showing multiple strictures. Note two in middle of pendulous portion and a much wider one with a false passage behind it through which a filiform has been inserted. Also note dilatation of urethra behind this stricture of bulbous portion. (Courtesy of Prof. G. Marion, Paris.)

FIG. 199—In left hand diagram, the size of the lumen of the normal male urethra is shown as compared to that of a stricture with a central orifice (concentric) as shown, in middle illustration, and one with an eccentric orifice as shown at right.

200) through which a filiform (Fig 75) cannot be passed although urination is but little impaired.

(c) **Urinary Symptoms.** Urinary frequency is often marked during the day but there is very little or none during the night, in contradistinction to prostatic hypertrophy in which nocturia is often quite marked. Prostatic hypertrophy and stricture are seldom found in the same patient. Occasionally the patient with a small contracture of the bladder neck or a median bar may also have a urethral stricture. An associated cystitis as the result of infected residual urine will cause

some urgency and dysuria. This cystitis is associated with a narrow stricture and clears up and reappears at intervals. The associated prostatovesiculitis may also produce urinary frequency.

(d) **Retention of Urine** This is usually acute. In strictures of small caliber varying degrees of chronic retention may present. In some, the bladder may become quite distended and the patient able to void only a little.

Acute retention is a not uncommon complication, due to edema of the urethra at the point of stricture in the bulbomembranous portion. It is usually brought about by chilling, cold, alcoholism and voluntary retention of urine. Most attacks are relieved spontaneously by the relief of the congestion, following application of heat in the form of hot sitz baths and heat to the perineum. These attacks tend to recur so that a patient may go through a number of attacks of acute retention in a few years. Sometimes the retention is gradual in onset, the bladder becoming gradually distended until acute retention occurs.

(e) **Hemorrhage** may occur in some strictures, but is not a common finding. Hemorrhage following instrumentation is, however, not unusual.

(f) **Involvement of the Seminal Ducts** Prostatovesiculitis is often associated and may present symptoms such as backache, pain in perineum and referred pains to the thighs. Epididymitis will sometimes develop within twenty-four hours after forceful instrumentation for tight strictures in which there is an associated vesiculitis.

(g) **Sexual Symptoms** Although impotence is due to the associated prostatovesiculitis it often clears up with the dilatation of a stricture. Painful erections or incurvation of the penis may result from strictures in the pendulous urethra. The orgasm may be painful and in some narrow strictures, the ejaculated semen does not appear at the meatus because of the obstruction, but regurgitates into the bladder.

COMPLICATIONS OF STRICTURE

Damage to the Kidney The long standing back pressure and infection may produce a pyelonephritis and sclerosis of the kidney. This usually comes on insidiously, shortens the life of the patient in long standing obstruction and may be the cause of a fatal termination.

Urethral Fever Following an instrumentation the patient may develop a chill followed by a fever which rapidly rises to 103 or 104° F. This usually develops within twelve hours. The fever remains stationary for twenty-four to seventy-two hours and then gradually recedes. The most common type of attack lasts from three to seven days. The patient may have repeated attacks. This urethral fever is merely due to the sudden entering into the blood stream, of bacteria which have been stirred up by the instrumentation and enter through the traumatized area. With it, there usually develops a mild degree of pyelonephritis and thus the kidneys bear the major portion of the burden in these attacks. Following operative procedures, such as urethrotomy in which there has been an associated periurethral abscess (Fig 188) instrumentation will often bring on a chill and fever. This cycle of chills and fever is like that following the injection of foreign protein intravenously.

Periurethral Abscess and Fistula. (Figs 188 and 196) Periurethral abscess which does not immediately follow a gonorrhea is practically always the result of stricture. The abscesses and fistulae in the perineum (Fig 197) associated with a long standing periurethritis are relieved by incision, but will recur unless a urethrotomy is also done. These fistulae may be multiple and extend into the scrotum producing multiple abscesses and considerable scarring and infiltration of the perineum. They must all be dissected out these fistulae of long standing often becoming epithelialized and persisting unless this is done.

Periurethral Phlegmon or Urinary Extravasation. This is a serious complication and very often fatal. The extravasation is limited by the fasciae of the perineum and penis (Fig 48). Urinary extravasation may occur from injury to the urethra or bladder or from other causes. The subject of urinary extravasation will be taken up later in this Chapter.

CLINICAL COURSE OF URETHRAL STRICTURE

The clinical picture of urethral stricture varies considerably. Some present no symptoms other than a urethral discharge. Others show symptoms of interference with the urinary stream and attacks of acute retention. The vast majority are modified by treatment. Strictures beginning soon after a gonorrhea will present early evidence of contraction with a dense scar. Others develop after many years will not contract much. The onset is usually slow and insidious many years passing before the stricture gives rise to symptoms.

Strictures are classified clinically into (a) those of wide caliber (b) narrow caliber (c) filiform strictures (permitting only the passage of a filiform) and (d) impermeable. Some are (a) linear (Fig 198) presenting merely a band across the urethra, others are (b) annular (Fig 198) having a wide ring of scar. The majority are (c) tortuous (Fig 200). The hard fibrous stricture very seldom bleeds after instrumentation and does not respond much to dilatation. The ordinary stricture responds favorably to dilatation. The elastic and resilient stricture which responds temporarily to dilatation contracts again very rapidly in the intervals between dilatations. These elastic and resilient strictures are also painful to instrumentation and bleed readily.

DIAGNOSIS OF STRICTURE

The diagnosis of a stricture is based upon the history, symptoms and instrumental examination.

BY INSTRUMENTAL EXAMINATION

The olive tipped bougie or sound (Fig 74) is the most valuable instrument in the armamentarium for the diagnosis of stricture of the anterior urethra. It determines the presence and location of a stricture. The olive tip gives a "jump" which can be distinctly seen and felt when passing the stricture. The olive tip is the same in principle as that used for diagnosis of strictures elsewhere. The olive tip readily passing beyond the stricture and meeting with the obstruction on its way out when its widest portion meets the stricture. For strictures of the posterior urethra however the bulbous bougie is of little value unless it be curved and even

then the narrow membranous urethra and the triangular ligament (Figs 46 and 51) may apparently show an obstruction that does not exist

Sounds (Fig 77) Aside from their therapeutic value, they are of aid in determining the presence of stricture. A definite obstruction or an infiltration that allows the instrument to pass through only with difficulty, is diagnostic of stricture. The strictured bands can be felt over the sound. Periurethral infiltrations in chronic urethritis which are marked when palpated (Fig 92) over a sound, may present very little or no infiltration in the urethra and are not diagnostic of stricture. When meeting with an obstruction, force should not be employed, but smaller sized instruments should be used to pass the stricture.

Bougies (Fig 76) Bougies can be inserted with considerably more force than a metal instrument and for strictures of caliber³ 18 French or less, they

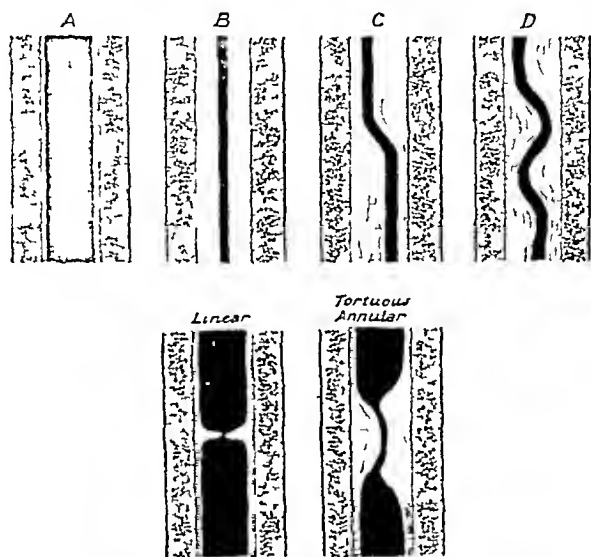


FIG 200—In the upper diagram are shown A caliber of normal urethra, B, reduction of lumen by stricture with central opening, C, with bayonet channel, and D, with tortuous channel. In the lower illustration are shown a linear and a tortuous stricture.

should always be employed in place of a sound. The danger of traumatizing the urethra or making false passages (Fig 194) with small caliber, sharply pointed metal sounds is so great, that only those with large experience should use them. The stricture, if somewhat difficult of passage, grasps the bougie very tightly so that considerable force must be used to withdraw it. In some cases, one can almost lift the patient from the table in removing the tightly grasped bougie. This characteristic grasping of the sound or bougie, interfering to a greater or lesser degree with its withdrawal, is diagnostic of stricture.

Urethroscope The rigid infiltrated urethral mucosa can be seen with the urethroscope (Plate I) as can also the eroded, ulcerated and inflamed areas around the scar which appear white in old strictures. Often slight areas of calcification are seen as plaques of incrustation.

BY MEANS OF CLINICAL FINDINGS

Chronic anterior urethritis presents itself as a persistent discharge and some infiltration in the urethra but without narrowing of the caliber. An instru-

³ See remarks on scales in Chapter IV

ment can be inserted with ease. This infiltration practically never becomes a stricture.

Prostatic Hypertrophy The prostatic age is much later than that for stricture which usually appears between twenty and thirty. The prostatic urethra⁴ is tortuous and elongated. The tortuous prostatic urethra can practically always be catheterized with a Mercier catheter of good caliber, even in the presence of retention.

Papillomata, foreign bodies and congenital anomalies can be diagnosed urethroscopically.

PROGNOSIS

The gonorrheal stricture consists of scar tissue which is infiltrated with elastic fibers, in distinction to a traumatic stricture which is a scar throughout. The gonorrheal stricture has normal tissue at its base and is only partly scar. The majority of gonorrheal strictures will respond to dilatation and can usually be dilated to almost the normal caliber of the urethra. In some cases after a prolonged continuous dilatation of some months the stricture will contract very little afterward. Usually however dilatation is necessary for many years at intervals of a few months to a year in order to prevent contraction. One can never assure the patient that the stricture will not contract if left alone. Since a stricture is partly scar tissue it can never be cured.

With beginning soft infiltration rapid dilatation with the Kollman dilator may prevent the formation of any appreciable hard infiltration or stricture but even here sounds are preferable. The dilator has hardly a place in treatment, in our opinion and is practically an obsolete instrument.

TREATMENT OF STRICTURE

GENERAL CONSIDERATIONS

Gradual and continuous dilatation until the greatest amount of dilatation has been accomplished or until the normal caliber of the urethra has been attained constitutes the treatment of urethral stricture. This maximum point of dilatation should be carried up to the normal caliber and somewhat beyond normal because a stricture had better be somewhat over-dilated, than under-dilated in view of its tendency to contract and this dilatation should be maintained by intermittent passage of sounds over a number of years.

Wherever it is at all possible strictures should be dilated rather than operated. In the last decade or two urologists have become conservative in the management of strictures, so that an external urethrotomy⁵ is a rare operation in private practice and internal urethrotomy has become obsolete.

Urethrotomy However there are certain definite indications for urethrotomy which cannot be avoided. A stricture which bleeds with each instrumentation is elastic and re-contracts during intervals between dilatation should be operated. Perineurethral abscess (Fig 188) or fistula in the perineum (Fig 197) usually recurs unless a urethrotomy is done at the time that the abscess or fistula is

See Chapter 18
See Chapter 48

then the narrow membranous urethra and the triangular ligament (Figs 46 and 51) may apparently show an obstruction that does not exist

Sounds (Fig 77) Aside from their therapeutic value, they are of aid in determining the presence of stricture A definite obstruction or an infiltration that allows the instrument to pass through only with difficulty, is diagnostic of stricture The strictured bands can be felt over the sound Periurethral infiltrations in chronic urethritis which are marked when palpated (Fig 92) over a sound, may present very little or no infiltration in the urethra and are not diagnostic of stricture When meeting with an obstruction, force should not be employed, but smaller sized instruments should be used to pass the stricture

Bougies (Fig 76) Bougies can be inserted with considerably more force than a metal instrument and for strictures of caliber³ 18 French or less, they

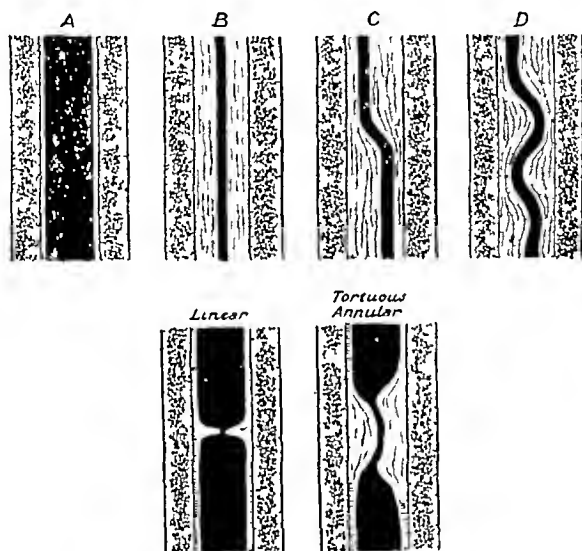


FIG 200—In the upper diagram are shown A, caliber of normal urethra, B, reduction of lumen by stricture with central opening, C, with bayonet channel, and D, with tortuous channel In the lower illustration are shown a linear and a tortuous stricture

should always be employed in place of a sound The danger of traumatizing the urethra or making false passages (Fig 194) with small caliber, sharply pointed metal sounds is so great, that only those with large experience should use them The stricture, if somewhat difficult of passage, grasps the bougie very tightly so that considerable force must be used to withdraw it In some cases, one can almost lift the patient from the table in removing the tightly grasped bougie This characteristic grasping of the sound or bougie, interfering to a greater or lesser degree with its withdrawal, is diagnostic of stricture

Urethroscope The rigid infiltrated urethral mucosa can be seen with the urethroscope (Plate I) as can also the eroded, ulcerated and inflamed areas around the scar which appear white in old strictures Often slight areas of calcification are seen as plaques of incrustation

BY MEANS OF CLINICAL FINDINGS

Chronic anterior urethritis presents itself as a persistent discharge and some infiltration in the urethra but without narrowing of the caliber An instru-

³ See remarks on scales in Chapter IV

meat can be inserted with ease. This infiltration practically never becomes a stricture

Prostatic Hypertrophy The prostatic age is much later than that for stricture which usually appears between twenty and thirty. The prostatic urethra¹ is tortuous and elongated. The tortuous prostatic urethra can practically always be catheterized with a Mercier catheter of good caliber even in the presence of retention.

Papillomata, foreign bodies and congenital anomalies can be diagnosed urethroscopically.

PROGNOSIS

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Wherever it is at all possible strictures should be dilated rather than operated. In the last decade or two urologists have become conservative in the management of strictures so that an external urethrotomy is a rare operation in private practice and internal urethrotomy has become obsolete.

Urethrotomy However there are certain definite indications for urethrotomy which cannot be avoided. A stricture which bleeds with each instrumentation is elastic and re-contracts during intervals between dilatation should be operated. Perineal abscess (Fig. 188) or fistula in the perineum (Fig. 190) usually recurs unless a urethrotomy is done at the time that the abscess or fistula is

¹ See Chap. 11
See Chapter 4

treated Urinary extravasation due to urethral stricture is also a definite indication for urethrotomy

In the vast majority of cases, however, the patient gets along well without a urethrotomy even in the presence of filiform strictures (Fig 199) Careful attention and persistence in treatment will be followed by a urethra of good caliber It is well to remember that urethrotomy is only preparatory to sounding Cutting the strictured area permits dilatation and unless this is done, the stricture and scar contract and leave the patient worse off than without his operation

INSTRUMENTS

Instruments necessary for dilatation are filiforms (Fig 75), bougies (Fig 76) and sounds (Fig 77)

Dilators such as the Kollman, are employed but little at present The straight Kollman dilators, however, may be of value in breaking up soft infiltrations in the anterior urethra and may also be used when there is a tight meatus and the patient refuses meatotomy They traumatize the urethra and in most instances do not dilate, but tear the stricture, which is more harmful than beneficial Posterior dilators such as the Kollman curved dilator, produce considerable trauma in the prostatic urethra and may set up a prostatovesiculitis or epididymitis They also traumatize the inelastic triangular ligament (Fig 48) With the passing of time, many of the varied types of instruments formerly used in the urethra, have been abandoned and we have been left with the few above mentioned, which have been found to be practicable and of value The chief reliance



FIG 201—Banks bougie of woven silk A very useful instrument for dilating a urethral stricture of very narrow caliber

for dilatation is the conical sound (Fig 77) The filiform (Fig 75) is used for strictures of a caliber up to 8F and the woven silk bougie (Fig 76) for strictures up to 18 French and somewhat beyond

Filiforms There are two types of filiforms in use, the whalebone (Fig 75) and the woven silk The woven silk has screw attachments for followers (Fig 79) which are of great value These must be used with caution, the filiform may become detached and remain in the bladder, or may bend in the urethra and break, and may be cut off when used as a guide in external urethrotomy The Banks bougie (Fig 201) or Hunter's wedge, is the best filiform to use for rapid dilatation without the danger of a filiform breaking off or becoming detached, as in the Le Fort sound

THE DILATATION OF A STRICTURE

In order to cover the subject it is best to begin with the filiform stricture

The patient may have a fair stream and yet have an impermeable stricture The tortuous stricture (Fig 200) prevents the passage of the filiform Even though the stricture may be impermeable to the filiform, attempts to pass it help to dilate the stricture One finds after a few days of repeated attempts to pass a filiform, that the latter will finally pass This is brought about by the edema and resultant absorption of the exudate at the strictured area, which the filiform has impinged upon

In attempting to pass a filiform one must have considerable patience and make repeated attempts with four or five filiforms in the urethra, manipulating back and forth and slipping one alongside (Fig 202), the other until one slips by. One stricture may be passed and then another encountered and after some manipulation one may get past all of the strictures and into the bladder. When one has been inserted another may be slipped alongside. Spiral arrangements for the ends of the filiforms or those with a special bend at the tip (Fig 75) are preferred by some for passing through tortuous strictures (Fig 200). When the filiform has been passed it may be left in place and attached by adhesive to the penis allowing the patient to urinate alongside it, in cases of subacute or chronic retention. It may be removed and reinserted every second and later, every third day until a larger instrument can be passed. The filiform with a screw attachment for a Le Fort follower (Fig 79) permits the rapid dilatation of the stricture the filiform acting as a guide for the sound and curling up in the bladder. The Banks bougie is usually preferable to the Le Fort as stated above and has none of its disadvantages. If a follow up sound (Fig 79) has been passed one can wait four or five days before repeating the same procedure. With the rapid dilatations by follow up sounds, bougies need not be employed later and regular conical sounds (Fig 77) are used to follow up the treatment. One often finds that it is possible to pass a twelve to sixteen F sound where it has been impossible to pass a filiform. The thin filiform impinges on one of the projections of the tortuous stricture (Fig 200) whereas the sound does not impinge on the walls of the stricture and passes through. One must be careful in tying in a filiform—it may slip back into the bladder.

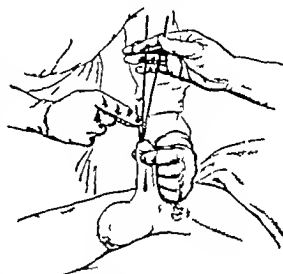


FIG. 202.—How to pass a number of filiform bougies so that one will pass through a stricture opening. (See text.)

Bougies are inserted without any special technic. The penis is pulled up and the instrument pushed downward thus accommodating itself to the urethral curve. They may be used up to No. 28 French or beyond particularly in strictures that bleed readily when a sound is passed. Usually however after it has been possible to pass two filiforms alongside each other the treatment is followed up with gradually increasing sizes of bougies (Fig 76) until 18 or 20 French has been reached when metal sounds begin to be employed. There is less danger of trauma and false passages (Fig 194) from a semi rigid instrument than from a metal sound.

The therapeutic value of a sound is not so much the actual dilatation with the instrument which is of value but the indirect effect as the result of the trauma produced. Following the instrumentation for the first twenty four hours there is some edema and congestion at the strictured area which interferes somewhat with urination. This edema and hyperemia subside and as an indirect effect of the inflammatory reaction there is absorption of some of the scar and infiltrate

thereby producing dilatation. Strictures are dilated, not stretched or torn, to get results. A sound should be left in place but a few seconds to obtain the desired effect.

In filiform strictures it is necessary to pass filiforms every forty-eight hours until a bougie can be passed, after which, the interval can be every three or four days until a No. 18 sound can be passed. Five days is a good interval for passing sounds during the active stage of dilatation. After the urethra is dilated, a sound may be passed once every two weeks, later once a month and the patient should be seen and treated two or three times a year thereafter.

In passing sounds, it is well to begin with a smaller size first and then change to larger sizes at each treatment. One will find it much easier to pass the desired maximum caliber at each sitting by starting with a smaller caliber first. Thus, if at the last treatment the urethra has been dilated to twenty-four and this time the operator wishes to pass a No. 25, he should begin with a No. 23, then 24 and finally, a 25.

Following the passage of a sound, instillation (Fig. 106) of silver nitrate of gradually increasing strengths beginning with one-eighth per cent up to two per cent later in the course of treatment, is practiced by many. It acts as a stimulant and astringent. Others prefer to irrigate the urethra and bladder afterward, with a mild potassium permanganate solution. All these, however, are unnecessary, for the mere passage of a sound accomplishes all that is desired.

Meatotomy In about fifty per cent of cases of chronic anterior urethritis, the narrow meatus which is present undoubtedly helps to prolong the discharge because of poor drainage through its narrow orifice. Meatotomy is indicated in some of these to allow the passage of larger calibered instruments. For dilatation of a stricture, meatotomy is also often indicated in order to insert sounds of large caliber. The technic will be discussed under Operations on the Urethra and Penis.

TREATMENT OF ACUTE URINARY RETENTION DUE TO STRICTURE

The patient who has had one attack knows when another is impending by the beginning difficulty in urination, inability to pass much of a stream, later only a few drops, and then complete retention. The patient is in considerable distress during the attack, the added straining in attempting to urinate aggravates the edema and congestion about the stricture and the bladder neck.

Placing the patient in a hot bath for fifteen to thirty minutes, often relieves the congestion and edema and allows him to begin urinating spontaneously, first a few drops, then a little more until after ten to fifteen minutes, the bladder has emptied itself. The relief may be only partial or temporary and the retention recur. However, a hot bath may not always relieve him.

With careful manipulation, a filiform (Fig. 75) can often be passed and the patient urinates either alongside it or after it has been withdrawn. With a filiform in place, a screw Le Fort sound as a follower (Fig. 79) can be passed and then upon its withdrawal the patient has immediate relief and empties his bladder. Hot baths, rest in bed, evacuation of the bowels and heat to the perineum should follow partial or complete relief of the retention, in order that it may relieve the congestion in the perineum and around the stricture.

If, after all these methods and attempts have failed the insertion of a trocar into the bladder is indicated the trocar is inserted in the median line or immediately to one side of the median line about two inches above the pubes. This gives immediate relief which should be followed up by the methods above outlined. In order to avoid repeating the procedure, a small catheter can be inserted through the trocar similar to that used in draining an empyema, this catheter remaining in place two or three days. After that one will be agreeably surprised to note that with the relief of congestion and straining a filiform can be passed through the stricture.

The purpose of all these conservative measures is first, to avoid doing an external urethrotomy with a patient acutely ill, and without a guide when such an operation is a difficult procedure. Secondly if it is once possible to pass a filiform, an external urethrotomy can be entirely avoided and the urethra gradually dilated to good proportions, without any cutting operations.

As stated previously however, a urethrotomy is sometimes indicated for fibrous strictures that do not dilate also for elastic bleeding strictures and where a patient desires rapid relief.

Internal Urethrotomy is Rarely Indicated. The deeper strictures of the anterior urethra can be divided through the external urethrotomy incision and when external urethrotomy is not done the strictures in the pendulous urethra can usually be dilated. Never do an external urethrotomy for strictures of the pendulous urethra (Fig 193). Permanent fistula may result because the urethra will not close where it has no supporting tissue. Internal urethrotomy produces considerable scarring and often results in permanent incurvation of the penis.

Strictures of the Urethra in the Female. This subject is covered in Chapter 45 on Urology in the Female.

COMPLICATIONS

URINARY EXTRAVASATION

This may occur anywhere along the urinary tract. Injuries to the bladder, kidney and ureter producing intra extra and retroperitoneal escape of urine will be discussed more fully in special chapters. It is interesting to note the ability of the peritoneum to tolerate large quantities of uninfected urine for many days. Deep urinary extravasation results from injuries to the urethra behind the triangular ligament and also in the extra-peritoneal rupture of the bladder. In deep urinary extravasation the urine may infiltrate the fascia at the base of the bladder and surround the bladder.

In urinary extravasation or infiltration of urine into the tissues of the perineum following an injury to the pelvis or perineum there is usually a clear history so that the condition is readily diagnosed. In injuries to the bones the urethra may be torn across the patient is unable to urinate or free blood comes from the meatus. Within a few hours a tumefaction develops in the perineum which spreads gradually and at times rapidly to the scrotum, anterior abdomen and penis (Fig 48). The deep form of urinary extravasation is less readily diagnosed. It is frequently present in association with the superficial urinary extravasation and is often overlooked. Superficial urinary extravasation is usually the result of infection and erosion around and behind a stricture. This subject is discussed

at length here because of its importance in relation to organic stricture of the urethra. Superficial urinary extravasation is best termed peri-urethral phlegmon for there is always an associated peri-urethritis present. This condition presents a different picture of onset as compared with urinary extravasation following trauma.

The patient has had urinary difficulty for a number of years and may have had one or more attacks of acute retention. He may also have had considerable periurethral infiltration about the bulbomembranous urethra or periurethral abscesses (Fig 188) and fistulae (Fig 196). This individual with a tight stricture, who is a fit subject for an acute retention, goes on an alcoholic bout. His bladder becomes distended and in his stuporous condition he is less sensitive to the distention. The weakened (Fig 203), eroded, infected area in and about the stricture gives way and urine begins to infiltrate. He is usually brought in twelve to twenty-four hours later, in a stuporous or toxic condition, a very sick man, having been picked up on the street and brought to the general hospital. An attempt may have been made to pass a sound. The resultant trauma or actual false passage (Fig 203) may have brought about his extravasation.

In those associated with infection, the onset is gradual and the infiltration may be limited to a small area in the scrotum or perineum, because of the relatively small amount of urine infiltrating. These patients recover rapidly. They often have old fistulae and scars in the perineum from previous infection.

Anatomic Consideration (See Fig 48) The triangular ligament, a very tough membrane⁶ through which the membranous urethra passes, is the barrier which prevents any extravasation of urine in front of it or in front of its posterior layer, from passing into the deep perineal tissues and into the retro- and perivesical space. Rupture of the prostatic urethra results in deep urinary extravasation, that in front of the triangular ligament is termed superficial extravasation. Colles' fascia firmly attached to the ischiopubic rami, fusing in front with the suspensory ligament (Fig 48) and deep fascia of the penis and extending laterally to the thighs, limits the progression of the extravasated urine along certain planes and allows for the only outlet of the escaping urine in front to the loose cellular tissues (Fig 203) of the scrotum and lower abdomen.

Buck's fascia (Fig 48) of the penis covers both corpora cavernosa and unless the rupture is in the scrotal or pendulous urethra, this fascia prevents any infiltration except in the superficial tissues of the penis.

Etiology Urinary extravasation results from considerable tension on the already weakened urethral wall (Fig 203) about the stricture together with erosion and infection in this portion of the urethra and produces ulceration and gangrene. The destruction of tissue and the generalized sepsis while due in part to the extravasated urine itself is considerably aggravated and may be to a large extent due to severe secondary infection accompanying it. The extravasated urine from the stricture is practically always infected with virulent organisms. However, the term "urinary extravasation" is a misnomer, for in 50 per cent of the cases there is no obstruction to the passage of a sound, and no stricture is found, and there is apparently no loss of continuity of the urethra. In another 25 per cent, the urethra appears intact, and although a stricture is present it is amenable to

⁶ This is true of the anterior layer as Wesson (Fig 48) has shown.

passage of the instrument, in only 25 per cent is an impermeable stricture present in which there is also an extravasation of urine. The term peri urethral phlegmon describes this condition far more accurately. It is a severe infection with a streptococcus, producing marked toxemia and rapid infiltration of the tissues.

Symptoms The symptoms depend upon the location of the rupture, the virulence of the associated infecting organism, and the duration of the extravasation.

If the extravasation is slow and gradual, it may be followed by a peri urethral abscess which can be absorbed or a local slough alone develops with a periurethral fistula (Fig 196) as an end result. This is nature's method of curing the gradually developing extravasation. If the process is acute and the escape of urine rapid, the typical picture of acute urinary extravasation presents itself.

This consists of a red inflammatory painful swelling (Fig 203) developing



FIG. 203.—Front and side views of the scrotum in a case of extravasation of urine at an early stage of the infiltration of the scrotal tissues.

in the perineum gradually extending upward rapidly infiltrating the loose cellular tissue of the scrotum and then extending to the lower abdomen above the pubes and upward upon the abdomen. The fully developed extravasation is usually seen within thirty-six to forty-eight hours after the onset. The patient is very toxic.

If the rupture is in the pendulous urethra the urine will pass along the fascial planes and finally extend to the glans penis. The appearance of a black spot on the glans penis after extravasation is usually a serious finding.

When the prostatic urethra ruptures the extravasation is back of the triangular ligament (Fig 48) and is deep. The urine passes into the ischio-rectal fossa, backward over the buttocks or it may burrow around the rectum and into the perivesical space and tissues. It may extend superficially by burrowing into the weak fascial planes between the rectum and urethra.

The patient with a well developed picture of penurethral phlegmon presents himself as a very sick individual more or less irrational, an anxious and flushed expression, a rapid irregular pulse, rapid respiration, elevated temperature, dry coated tongue and fetid breath.

Following the brawny redness, there is necrosis and sloughing of the more superficial tissues in localized areas

Differential Diagnosis Although the evidence at hand is usually so distinct that a diagnosis can readily be made, the following must at times be differentiated

PERI-URETHRAL ABSCESS This does not extend rapidly, the swelling is localized, and the patient is not toxic. Infection is due either to bacillus coli, or staphylococcus. Occasionally peri-urethral abscess may spread and develop into a peri-urethral phlegmon

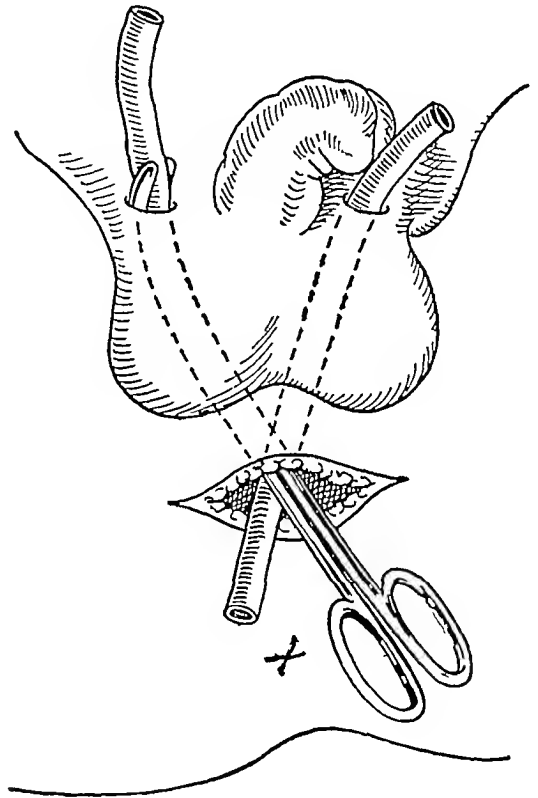
ACUTE SEVERE EPIDIDYMITIS with much edema of the scrotum may simulate extravasation

FIG 204



FIG 204—Periurethral phlegmon. Note multiple incisions and extensive gangrene of skin of lower abdomen. Patient recovered.

FIG 205—Method of through and through drainage of scrotum and perineum employed in cases of urinary extravasation.



HEMATOMA IN THE PERINEUM often precedes extravasation in traumatic rupture and may be mistaken for an extravasation

Prognosis The prognosis is grave. The patients are usually seen when the extravasation is well-developed and the toxemia marked. The mortality is high in these cases. If diagnosed early, when there is only swelling in the perineum and slight extension, there is very little sepsis and if the patient be operated at once, the results are excellent and the mortality low. Usually however the fully developed extravasation is seen and the patient is in a serious state before he comes to the operating table.

Treatment The treatment is surgical. Incise all infiltrated areas widely and deeply. Make multiple incisions in the various tissues (Fig 204). Do an external urethrotomy and insert a tube in the urethra.

We have done cystotomy in some cases where there was no evidence of

stricture of the urethra for the purpose of diverting the urinary stream. These patients got along well. Extensive free incisions of the involved tissues is important. Post-operative care consists of continuous heat and frequent irrigations and dressings with potassium permanganate. The toxemia should also be treated.

CHRONIC URINARY EXTRAVASATION This is the term given many years ago by Fuller to various types of slow extravasation, particularly, however, to the extensive multiple abscesses and fistulae secondary to urethral stricture. In the more marked and neglected cases, the perineum, buttocks, scrotum, suprapubic and inguinal regions are riddled with abscesses and urinary fistula following rather closely the path of superficial urinary extravasation.

As in some of the milder forms of acute periurethral phlegmon in which the perineum and scrotum only become involved, these abscesses and fistula may likewise be limited to this area.

The patients usually have had one or more external (perineal) urethrotomies. Occasionally cystotomy has been done for the relief of acute urinary retention or for the purpose of combining cystotomy and urethrotomy in operations for the relief of impermeable strictures.

There is often a history of one or more attacks of acute urinary extravasation, usually of mild degree. Occasionally there is a history of an extensive urinary extravasation. While in the main the development of multiple abscesses and fistula is due to gross neglect on the part of the patient, they are occasionally the result of poor operative and post-operative management. These patients have a permanent perineal urinary fistula, do not urinate through the meatus, and urine passes outward in many directions from the various fistulous tracts described as the sprinkling pot perineum.

A brawny edema of the scrotum and also of the penis (Fig. 206) occasionally develops. This is due to lymphatic stasis secondary to scrotal infection and also to some extent, as result of chronic adenitis of the inguinal glands. This condition is not a rare cause of minor forms of non-filarial elephantiasis.

Not all impermeable strictures resulting in perineal fistula develop multiple abscesses and fistula.

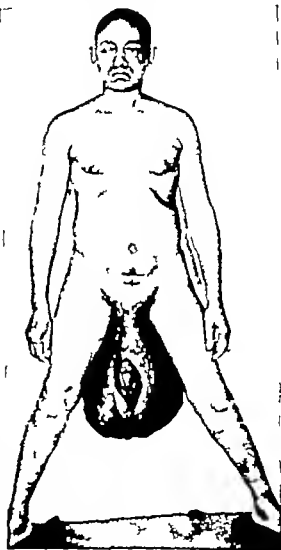


FIG. 206.—Elephantiasis of the scrotum secondary to chronic urinary extravasation with multiple fistula formation. Excellent result following removal of scrotum and penis. Entire mass weighed 45 pounds.

CHAPTER 14

GONORRHEA IN THE FEMALE

IRVING F STEIN, M D

ACUTE GONORRHEA
CHRONIC GONORRHEA
COMPLICATIONS
SEQUELAE
DIAGNOSIS

PROGNOSIS
TREATMENT
FEVER THERAPY
CHEMOTHERAPY
COMBINED METHOD

In women, gonorrhea is usually more widespread and far more serious than in men. This is due to the complexity and relationship of the female genitourinary structures. It may be either acute or subacute at the onset but is especially characterized by its chronic complications.

Etiology Gonorrheal infection in women is due to direct contact with an infected male, and practically never follows indirect transmission. The latter is the usual mode of infection in infants and young girls. The genitalia of the adult female are protected by the labia and by the vulvar hair against contamination by infected material on toilet seats, in bath tubs, on towels, etc. Furthermore, the gonococcus is very sensitive to drying, to heat and to the action of antiseptics, so that an indirect means of transmission is highly improbable.

There is no natural immunity to gonorrheal infection, nor does one attack protect the individual against subsequent infection. However, variations in degree of susceptibility to gonorrhea, are commonly observed. Gonorrhea is more readily communicable in the acute stage of the disease, but may also be transmitted in the subacute and chronic stages, in the latter, even after months or years of latency. When a woman is infected by a chronic carrier it may be difficult to demonstrate evidence of infection in the male partner, but a history of a previous gonorrhea in the latter, is usually obtainable.

ACUTE GONORRHEA

The symptoms of gonorrhea in the female vary directly according to whether the infection has been transmitted by a male suffering from an acute, or from one with a chronic gonorrhea. Acute gonorrhea in the female involves not only the urethra (Fig. 207) and endocervix¹ but frequently attacks Bartholin's glands, Skene's structures (Fig. 208) and the endosalpinx² as well. If the infection has been acquired from an individual afflicted with acute gonorrhea, there will usually be evidence of an acute urethritis within three to five days. Burning, itching and frequency of urination are often the earliest complaints. The urethritis may be accompanied by or be soon followed, by the appearance of a smeary yellow discharge on the vulva. The patient may complain of slight fever, headache and lassitude. The labia will be found bathed in a sero-purulent or yellowish purulent discharge, and the urethral mucous membrane appears swollen, red and

¹ Epithelial lining of the cervix uteri

² Epithelial lining of the fallopian tubes

protruding from the meatus. It, too, is covered with yellow pus. There may be two small red spots at the lower border of the meatus, the site of Skene's ducts (Fig. 208) and similar areas at the bases of the labia minora (the locations of Bartholin's ducts). Inguinal adenitis is not an uncommon complication.

These symptoms may be followed, as a result of upward extension of the infection, in a few days or a week, by more or less severe abdominal pain. This is

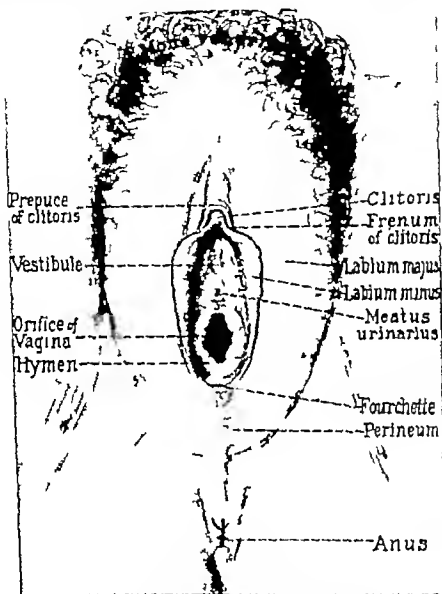


FIG. 207.—The external genitalia in the female.

due to the spread of the infection to the fallopian tubes. The pain is colicky in nature and may be associated with fever of 101° to 102°, nausea and vomiting and abdominal soreness. Frequency of urination and vesical tenesmus² may reappear. There is a constant sticky yellow vaginal discharge. The patient who develops salpingitis is usually obliged to remain in bed during this stage which if untreated may last from one to five weeks. The fever tends to subside rather rapidly and either continues as a low grade fever or disappears in a few days. The pain and soreness in the lower abdomen to which is often associated muscular rigidity of the abdominal wall may persist for two to five weeks. Occa-

²See Chapter 10

sionally the endosalpinx is involved without pain and fever, the distended tubes only being discovered on bimanual palpation. Stripping of the urethra in the acute stage with a finger in the vagina reveals considerable purulent secretion expressed from the urethra (Fig 93) and especially from the paraurethral glands of Skene (Fig 208). This manipulation may also prove somewhat painful.

Vaginal examination reveals considerable tenderness of the vulva and vagina, especially of the cervix and vaginal fornix. The bimanual examination may prove to be so painful that the patient will not permit its completion. The suprapubic region is held rigid so that the pelvic viscera are not easily palpated. The exquisite tenderness produced by moving the cervix and upon palpating both fornices is significant, indicating that the infection has spread to the fallopian tubes, with the development of acute salpingitis and pelvic peritonitis. Examination with the

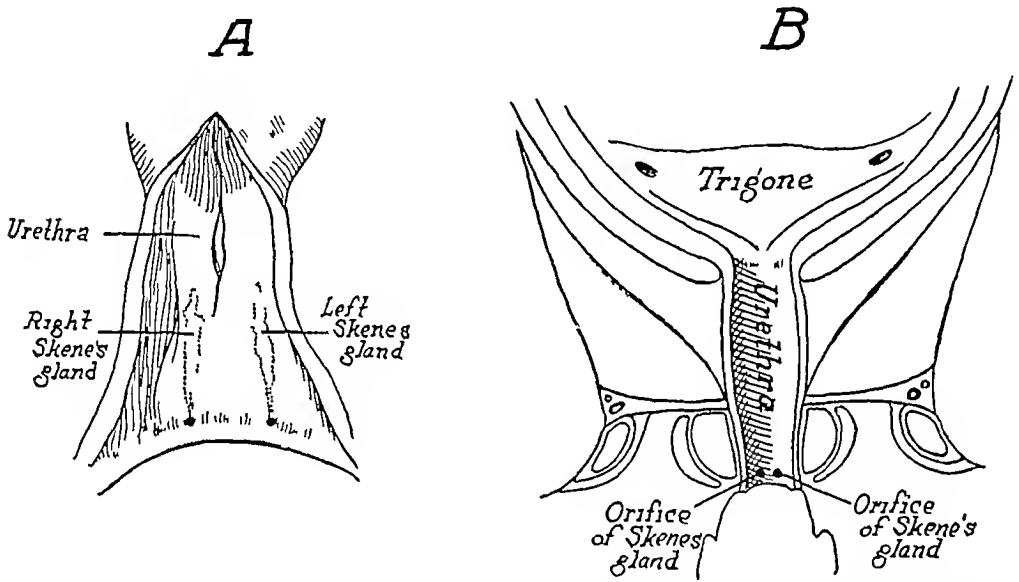


FIG 208—Female urethra as seen with anterior wall removed in A and in its relations to the adjacent pelvic strictures as seen in B. Note short length of the urethra. The orifices and suburethral locations of Skene's glands are well shown. (After Papin.)

bivalve vaginal speculum usually reveals a cervix which is swollen and from which a yellow muco-pus exudes from the external os.

The course of acute gonorrheal infection in the female depends upon the extent of the involvement. When limited to the urethra and endocervix, the acute manifestations may be brief. If Skene's glands are not infected, the urethra may regain its normal appearance in a few days. The acute endocervicitis may in the course of a week to ten days pass to the subacute and then to the chronic stage. Each is characterized by a yellow purulent discharge, becoming more muco-purulent with chronicity.

The course of an acute gonorrhea in the female is measurably lengthened by the advent of salpingitis. This is usually accompanied by a pelvic peritonitis which may subside after rest in bed, in a few days. Salpingitis, however, usually persists from three to five weeks with the patient in bed under the usual conservative management. The newer, more radical forms of treatment described below bid fair to reduce the inflammatory reaction to but a few days.

CHRONIC GONORRHEA

When the infection is transmitted by a male with chronic gonorrhea, the urethral involvement in the female is usually absent and symptoms of endocervicitis alone may develop. The woman may not suspect any trouble for ten days or more after exposure when she discovers a yellow vaginal discharge. This may be the sole symptom and if the cervix is promptly treated the infection may be cured without extension to other structures. When improperly treated salpingitis is likely to develop as a complication. The extent of gonorrheal involvement varies greatly in different individuals.

Skene's Glands Harbor Infection. When the urethra is infected Skene's glands (Fig 208) whose ducts lie just within the external urinary meatus, are usually attacked and it is these structures which tend to harbor infection the longest. After all signs of the disease have disappeared from other tissues pus containing gonococci may be expressed from Skene's ducts. This is one of the most significant factors in the tendency to latency which chronic gonorrhea in the female exhibits.

Bartholin's Glands Similarly Harbor Latent Infection. Often the resistant and intractable leukorrhoeas and the recurrences of more acute symptoms are due to chronic infection of Bartholin's and Skene's glands.

Site of Infection. In our experience the endocervix is the most frequent site of gonococcal infection in the female. According to Bumm however the cervix is affected in only 70 per cent of cases and the urethra in 93 per cent. Due to the racemose structure of the endocervical glands the infection in this location is deep seated and does not respond readily to medication applied to the surface. A thick yellowish or greenish muco-purulent discharge is characteristic of chronic gonorrheal endocervicitis. If this is of long standing it is associated with more or less reddening about the external os. Granular erosion of both anterior and posterior cervical lips is not infrequent in long standing cases. If the cervix has previously been lacerated ectropion is usually observed.

Gonorrheal endometritis about which so much has been written in the past is in most cases but a transient phase of the upward extension of gonorrhea. The endometrium is not as susceptible to the infection as are the endocervix and the endosalpinx. The organisms often pass to the fallopian tubes without producing any inflammatory reaction in the endometrium. The latter may be traumatized by means of medication carried beyond the internal os, or by instrumentation following abortion in women previously infected and thus the endometrium may be directly infected. When this takes place there is also usually evidence of a metritis and invariably extension to the fallopian tubes. The course of chronic endocervicitis is usually one to many months. Local treatment has but little effect upon it unless radical in type. Cauterization (Fig 209) or excision of the infected endocervix terminates the infection.

Chronic endocervicitis may also be complicated by extension upwards to the fallopian tubes the clinical course being similar to that following acute infection described above.

The endocervix may exhibit the tendency to latency described as true of infection of Skene's and Bartholin's glands and may be symptomless for months, and then recurrence takes place

Gonorrheal proctitis is perhaps more common than is generally believed. It may be produced by direct infection, or may be secondary to a genital gonorrhea. The use of the enema and the suppository should be interdicted in the presence of a gonorrheal discharge, in order to prevent rectal infection. Proctitis is usually mild and produces only symptoms of itching and discharge as a rule. Brunet and Salborg note the frequency of anal and rectal involvement in gonorrhea in the female. They studied 250 cases (42 per cent of all women with gonorrhea whom they had observed) in three years. The symptoms were mild, and abscess, fistula and ulceration infrequent. This may be the source of re-infection.

Verruca acuminata on the external genitalia are commonly the result of chronic gonorrheal discharge and cannot usually be eradicated, until the latter is successfully controlled. Destruction of Skene's ducts, cauterization of the endocervix, and enucleation of Bartholin's glands, may be necessary and the verruca destroyed by coagulation before complete success is attained.

COMPLICATIONS

Inguinal adenitis may accompany early urethritis. The glands rarely suppurate, although I have seen such a case, operated under the diagnosis of an incarcerated femoral hernia.

Trigonitis not infrequently results from extension upward of a gonorrheal urethritis, and very rarely pyelitis or pyelonephritis of gonorrheal origin occur. Gonorrhea does not as a rule extend beyond the trigone as the bladder mucosa is immune to the gonococcus.

Gonorrheal arthritis in the female is not uncommon and is more likely to occur when the urethra and trigone are involved. Too early, active treatment of the urethra may predispose to trigonitis and arthritis. In extremely virulent infections, a gonorrheal septicemia with endocarditis and pericarditis is a possibility, but it rarely occurs.

Pelvic peritonitis is a common accompaniment of salpingitis, but the infection tends to remain localized to the pelvis. Undue manipulation or surgical interference during an acute gonorrheal salpingitis, may cause extension to the upper abdomen. General peritonitis of gonorrheal origin is always very serious.

Salpingitis is so commonly a part of gonorrheal infection, that it must be regarded as a symptom of the disease rather than a complication. The extent of infection in the tubes may vary, however, from a mild endo-salpingitis to a severe suppurative process in which all coats are involved. It is often accompanied by oophoritis and pelvic peritonitis.

Bilateral pyosalpinx is a common termination of gonorrheal salpingitis, and is accompanied by extensive pelvic adhesions. In the less severe tubal inflammation, complete recovery is possible without evident damage to the oviducts. When suppuration occurs, however, the endosalpinx is severely involved and the tube walls are permanently thickened. The cilia may be destroyed, so that strictures and diverticula may be produced in the lumen of the tubes.

Ectopic Pregnancy. If the fimbriated end of the tube is open in such cases ectopic pregnancy is a likely sequel. Nodular salpingitis, in which the

tubes are obstructed by localized areas of scar tissue resembling small fibroids, is characteristic of chronic gonorrheal infection. The fimbria are frequently sealed by the inflammatory process resulting in tubal obstruction and consequently to secondary sterility. Inasmuch as gonorrhea is the cause of 30 to 50 per cent of sterilities in the female, one can judge the frequency of destructive tubal lesions due to this source.

Adhesions to the bowel and omentum frequently result from a severe inflammatory process in the tubes and render them susceptible to secondary infection. Mixed infection by *B. coli* and streptococcus, on the basis of an old gonorrheal pyosalpinx may give rise to a tuboovarian or a pelvic abscess.

Periappendicitis is not infrequent in gonorrheal pelvic peritonitis particularly when the appendix points toward the pelvis or is in close proximity to the tube.

Bartholinitis may result in an acute gonorrheal abscess of the labial gland or to the chronic stage may be the seat of mixed infection and this may likewise terminate in a Bartholin abscess. The latter ruptures spontaneously or may end in the formation of a Bartholin cyst.

SEQUELAE

Sterility and Tubal Pregnancy. The most serious of these in the female are sterility and tubal pregnancy. Sterility follows extensive tubal damage resulting in obstructive lesions. Salpingectomy may be required in these cases and necessarily produces sterility. Nodular salpingitis is typically a chronic gonorrheal lesion of the obstructive type. When the cilia of the endosalpinx have been destroyed, or when strictures, kinks or diverticula have been produced as a result of gonorrhea a period of sterility of variable duration often many years usually follows. If pregnancy follows at all, tubal pregnancy is the rule. Ectopic gestation may occur in one or both tubes and if such a tube is not removed surgically, it has been known to recur in the same tube. Intractable leukorrhea is another sequel of gonorrhea and is usually an evidence of latent infection in the endocervix, in Skene's or in Bartholin's glands (See above).

DIAGNOSIS

All purulent discharges from the female genitalia should be looked upon with suspicion. In the presence of vaginal discharge smears should be taken from the urethra after expression of Skene's glands and from the cervix. These are the two commonest sites of infection. When the area about Bartholin's ducts is visibly reddened smears may be taken after expression of the ducts. Small red spots near the orifices are significant of gonorrheal infection. In virgins vaginal smears may be required, when the cervix cannot be exposed.

Cultures are but rarely needed to diagnose gonorrheal infection. The typical smear in acute gonorrhea reveals numerous pus cells, with here and there a cell filled with typical biscuit or coffee bean shaped gram negative diplococci (Plate III). The absence of all other organisms in the smear is notable. A number of slides may be required before a typical gonococcus-laden cell (Plate III) is detected, but the freedom from all other organisms in the smear is significant. In the treated cases the appearance of other organisms and the reappearance

on the slide of Doderlein Bacilli, is evidence that the gonococci have been superseded by the other organisms

In the presence of mixed infection in cases of chronic gonorrhea, the gonococci may be found with great difficulty. Many smears stained by Gram's method may be required before gonococci are found. The clinical picture is of far greater significance in the diagnosis of chronic gonorrhea than is the smear, because this is often persistently negative.

A yellow mucopus issuing from the cervix is almost certain evidence of its gonorrheal origin. This may be associated with eversion of the swollen endocervix producing the so-called ectropion, or with actual erosion, but may also be unassociated with either of the foregoing lesions.

In the acute stage, gonorrhea is so typical that it is rarely mistaken. Positive smears from the urethra (Fig 93) and cervix, render the diagnosis certain. In patients with pelvic disease of long standing and in whom typical bilateral tubal swellings are found, the history will be more valuable in arriving at a diagnosis, than will smears. At times, the multiple foci of typical chronic gonorrhea may be diagnostic.

The complement fixation test is of questionable value.

PROGNOSIS

The tendency of gonorrhea towards latency should always be kept in mind when considering a clinical cure. Recurrence and extension of the infection are common. Tubal damage necessitating surgical removal is frequent, often requiring sacrifice of the ovaries and uterus. The course of uncomplicated gonorrhea in the lower urogenital structures in the female, is usually about six weeks.

TREATMENT

The treatment of gonorrhea has undergone a radical change in the past few years due to the development of (1) Fever therapy, (2) Chemotherapy, specifically, the use of Sulfanilamide, (3) Combined method of thermo- and chemotherapy.

1 FEVER THERAPY

While it is agreed that the untreated case of gonorrhea tends to run a typical course which is self-limited, the disease may persist from a few weeks to two or three months. Complete cure may be obtained by bed rest, local heat, personal hygiene and a complete avoidance of local treatment. But such conservative treatment is impractical, and attempts to control the infection by local antiseptic measures have in the past proved to be most unsatisfactory. Since it has been shown that the gonococcus is killed in vitro when exposed to a temperature of 41.5°C for six hours, a method of artificial fever therapy has been developed by which the body temperature can be raised for five to six hours and the gonococcus killed thereby in vivo. A large number of reports are to be found in the current literature indicating that at least 80 per cent of patients with gonorrhea can be cured by this means within two weeks. Owen says that this is true regardless of complications, and includes acute, subacute and chronic cases, even those complicated by pelvic peritonitis and arthritis. Only patients during pregnancy, or those suffering from debility, advanced vascular or renal disease,

and chronic alcoholism need be excluded from this fever therapy. While complications of a minor nature may result from sustained fever, only an occasional death has been reported.

The number of treatments required and duration of the treatment varies somewhat with different workers but the tendency is toward a single prolonged (10 hour) session at 41.5 C (106.7°F), which, according to Krusen, Randall and Stuhler, will produce negative cultures in a high percentage of patients with gonorrhea. They treated 361 (234 male and 127 female) patients with fever therapy with the result that 92.5 per cent of those who completed the treatment were cured and 100 per cent were definitely improved. Even patients with serious complications like gonorrheal endocarditis (H. A. Freund and W. L. Anderson) and gonorrheal septicemia with purpura (O. G. Hazel and W. P. Snow) were reported cured by fever therapy.

Fever therapy must be carried out in an institution with a trained personnel. The cases should be carefully selected and proper provision made for the treatment of possible complications resulting from treatment. Improvement in the technic of fever therapy is described by Blerman and Horowitz by combining systemic heating in the short wave cabinet with intra vaginal diathermy. Only from one to three treatments were required (average 1.4) with 93 per cent successful out of 121 cases.

Many urologists limit the use of fever therapy to those patients who have developed definite complications such as salpingitis or arthritis preferring routine local and internal medication for the uncomplicated cases. They also limit fever therapy to younger patients as they believe that patients over 40 years of age do not tolerate prolonged high temperatures well.

2. CHEMOTHERAPY

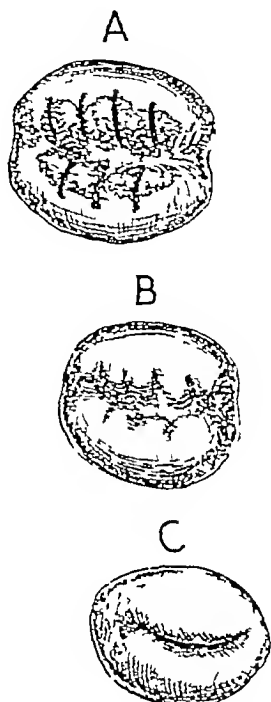
Sulfanilamide. Another mode of therapy which has shown remarkably favorable results in a majority of cases of gonorrhea is the administration of Sulfanilamide. Doses of from 60 to 80 grains per day usually beginning with the maximum dose for two days and then reducing it for the next 3 days to 60 grains per day may be administered if the dosage is well tolerated. 40 grains should then be the daily dosage until cure is obtained. This result may be anticipated in from 9 to 14 days. In some cases the smears become negative in 2 or 3 days but treatment should be continued providing there are no unfavorable effects noted. Extreme caution should be exercised however as more or less serious complications from its use have been reported. Especial care should be taken that no sulphates (especially magnesium sulphate) are administered while taking sulfanilamide or even for 48 hours before beginning treatment, because of the danger of the formation of sulfhemoglobinemia. At least one case of death has been reported (Paton and Eaton) from this cause. Methemoglobinemia is not uncommon in patients taking sulfanilamide, but it is less serious than the former condition and responds to the withdrawal of the drug and oxygen therapy. Transfusion is indicated to combat sulfhemoglobinemia.

Additional unfavorable sequelae in sulfanilamide therapy are drug fever which, like serum sickness, occurs on the 7th to the 10th days occasionally accompanied by a maculo-papular rash and leukocytosis. drug rashes without fever, exfoliative dermatitis, acute hemolytic anemia, acidosis, agranulocytosis,

and toxic optic neuritis. At the first indication of any of these complications, the drug should be discontinued. If cyanosis persists, a spectroscopic examination of the blood should be made for the detection of sulfhemoglobin, as this may persist for some time. If persistently present, transfusion should be resorted to.

Despite the above named dangers attendant upon its use, sulfanilamide has already proven to be one of the most efficient means of combating gonorrhea and when used cautiously there is practically no danger of ill effects. Its use in gonorrhea is being rapidly adopted and it may soon replace the older forms of treatment.

FIG 209



3 COMBINED METHOD

Combined artificial fever or thermotherapy and sulfanilamide administration have been em-

FIG 210

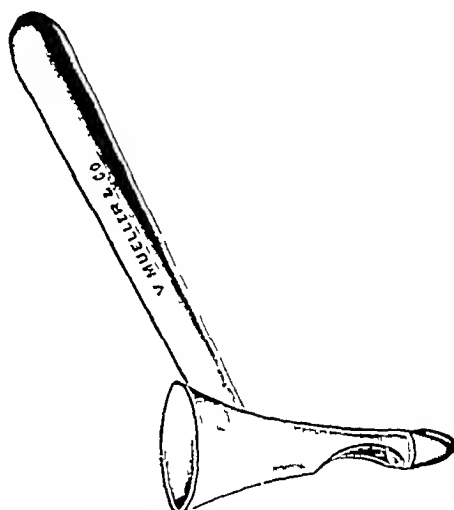


FIG 209—Linear cauterization of cervix for cure of chronic gonorrheal endocervicitis.

A Infected and eroded cervix, indicating cauterization with fine nasal type, wire cauter through whole depth of glandular layer.

B Appearance of cervix three weeks later.

C Cervix shrunk and epithelialized after six weeks. (Modified from Dickinson.)

FIG 210—Special speculum (termed Skenoscope) for treatment of infection of Skene's glands. When inserted with the handle directed obliquely upward, the orifices (Fig 208) of the glands appear through the opening in the speculum, which is in contact with the floor of the urethra. (Courtesy of V. Mueller and Company.)

ployed by Ballenger and others. The two methods have been used alternately and also simultaneously with satisfactory results. Obviously these newer methods are still on trial, whether employed separately or combined, but they show promise of completely revolutionizing the therapy of gonorrhea.

CAUTERIZATION DISINFECTION SURGERY

Residual cervicitis with ectropion, erosion or nabothian cyst formation is treated by linear cauterization (Fig 209), Hyam's conization with the endotherm tip, or by the Kimble or Cherry cautery. Topical applications and douches may prove to be of but little value except as an aid to hygiene. Cautery treatment is an office procedure, is practically painless and rarely requires repetition. In extreme cases of ectropion with chronic inflammation, it may be necessary to

excise the endocervical tissue. When this is indicated, the Stürmdorf tracheloplasty is most satisfactory and is preferable to amputation of the cervix.

When Skene's glands are found to be the seat of chronic infection and cause persistence of discharge an attempt is first made to disinfect them by the instillation of weak Nitrate of Silver solution or Mercurochrome 5 per cent, with the aid of a Skenoscope (Fig. 210). This can be done by means of a Luer syringe armed with a soft, silver blunt irrigating tip similar to that used in Vasotomy. Two or three instillations a few days apart will suffice to determine whether the process is yielding to treatment. When this treatment fails, the ducts are best split open over a probe or needle and the lining destroyed by the cautery or the cutting current. Local infiltration anesthesia often proves inadequate for such treatment. Bartholin's glands when they have suppurated or become cystic, require removal. Urethral strictures are not commonly found in the female as sequelae to gonorrhea, but when discovered, should be treated by dilatation with graduated sounds. Anal and rectal gonorrhea respond favorably to thermo- and chemo-therapy as described above. Late major sequelae such as chronic hydrosalpinx or tubo-ovarian abscess must, of course be treated surgically.

The Determination of Cure in Gonorrhea Is Difficult. Perhaps the newer methods of cure will prove to be followed less frequently than heretofore by recurrence due to residual or latent infection in Skene's Bartholin's or the cervical glands. However repeat smears and cultures should be taken for several months after a clinical cure occurs and coitus should be resumed only with the protection of the condom until the physician feels satisfied that recurrence is improbable.

CHAPTER 15

CHANCRE AND EARLY SYPHILIS

(PART ONE OF VENEREAL ULCERATIONS)

GENERAL CONSIDERATIONS

THE GENITAL CHANCRE

CLASSIFICATION

EXTRAGENITAL CHANCRES

THE CLINICAL CHARACTERISTICS OF THE CHANCRE

THE CLINICAL COURSE OF THE CHANCRE

DIAGNOSIS OF THE CHANCRE

DARK FIELD EXAMINATION FOR SPIROCHETAE

LOCATION OF THE CHANCRE

DIFFERENTIAL DIAGNOSIS

TREATMENT

FIVE COURSES

U S PUBLIC HEALTH SERVICE TREATMENT

GENERAL CONSIDERATIONS

To discuss the entire subject of syphilis would require a volume in itself. It is well covered in the various textbooks on dermatology, syphilology, and internal medicine. Chancre and early syphilis, however, most commonly come to the attention of the urologist, first. The immediate diagnosis of syphilis and the early treatment are in fact, far more important than the ability to diagnose and treat the later manifestations. It is for these reasons that this particular part of the subject is taken up here. Early syphilis consists of the primary lesion and the secondaries, the later evidences are classified as late or latent syphilis. Neurosyphilis and involvement of the cardio-vascular system are also late manifestations. For the purposes of treatment it is also well to classify syphilis into early or late. The advance made within the last twenty years in our knowledge of syphilis has been revolutionary and has greatly improved our methods of diagnosis and treatment.

The more important recent advances are

- 1 The serum diagnosis of syphilis by the Wassermann reaction, the Kolmer and Kahn tests
- 2 The use of the arsenicals and the heavy metals, especially bismuth, in treatment
- 3 Discovery of the *treponema pallidum* as the cause
- 4 The possibility of communicating syphilis experimentally to various animals

Etiology The *treponema pallidum* (Plate IV) is the causal organism of syphilis. Inoculated on the abraded, and frequently on the unbroken mucous membrane or skin, it produces the initial lesion or chancre in which it is found and it is present in all the later manifestations of the disease. It is a very delicate spirillum (Plate IV) and a parasite belonging to the protozoan group. It is a very delicate organism from four to fourteen microns in length and a quarter of a micron or less in diameter. It has from six to fourteen sharp, spiral coils resembling a corkscrew (Plate IV) in appearance. It progresses by rotating on its long axis and when at rest, shows undulatory movements in its entire length. It is stained with difficulty, the best methods being the Giemsa stain and the India ink method. These are discussed more fully in the various textbooks on bacteriology and parasitology. It can be stained in tissues by the Levaditi method.

For the purpose of making a rapid diagnosis the dark field method of examining for motile spirochetæ from the secretions of a suspicious lesion is far more satisfactory and simple (Plate IV). The spirocheta does not live long outside of the body, probably not over two hours, its life on the examining slide being as a rule not more than thirty to forty minutes and usually less. It has been cultivated with great difficulty. The spirocheta does not live in the dead body longer than eighteen hours. It is safe to perform a post mortem on a dead syphilitic fetus or baby twelve to eighteen hours after death. The organism has various strains and differences in appearance which can be readily noted by the experienced observer. It is believed that certain strains have greater predilection for and attack particularly certain parts or organs of the body. The biology of the spirocheta still requires considerable investigation. Some strains are more virulent than others. It is evident that with early care and intensive treatment the spirocheta has lost some of its virulence, for one does not see the malignant cases of syphilis now as in the past.

Predisposing Causes. The spirocheta can enter the intact mucous membrane or skin as has recently been demonstrated. A macro- or microscopic abrasion however is usually necessary. Direct contagion through coitus is the source of the vast majority of lesions, the spirocheta producing the initial lesion on the penis, vulva, vagina and cervix. Although syphilis is a venereal disease in most cases it may also be acquired as the result of kissing an infected individual, a wet nurse may acquire it from a syphilitic baby, or it may be acquired during surgical operations on syphilitic individuals through a cut on the finger. Indirect contagion is possible through infected drinking glasses, razors or through the medium of some article of clothing. Syphilis is peculiar to man, but may be produced experimentally in lower animals, such as apes, rabbits, guinea pigs, dogs and rats. There is no primary lesion in hereditary syphilis. The chancre is always present in acquired syphilis but may often not be discovered.

Pathology of the Chancre. The primary lesion is merely the local reaction against the invading spirochetæ. As soon as inoculation occurs and before the local lesion has appeared there is already systemic infection. The induration of the chancre (Fig. 211) is due to the cellular infiltration in the tissues and the thickening of the blood vessel walls. There is a marked round cell infiltration with vascular sclerosis for some distance beyond the lesion. This infiltration may be superficial or deep and as a result of the localized anemia there is either an erosion or ulceration. The latter is also due to the destructive action of the spirochetæ. A long tight prepuce under which the spirochetæ may harbor and multiply makes that individual more susceptible than one who has a short foreskin or who has been circumcised.

Types of Syphilis. The chancre alone together with a slight adenopathy but without the appearance of secondaries may be the only manifestation. Other cases may present a very malignant course from the onset with early cerebro-spinal syphilis. Some may become latent and not until many years later present evidences of tertiary lesions. There are various atypical forms which cannot be discussed in this short chapter.

Clinical Course (Incubation period). The incubation period before the appearance of the chancre varies considerably being anywhere from nine to ninety days or even longer. The usual period of incubation is about twenty-one

days It is well to remember that the patient already has systemic infection during the incubation period, but that this is not marked until two or three weeks after the appearance of the primary lesion

The Initial Lesion The most common location for the initial lesion is on the genitalia, following a definite history of exposure Extra genital chancres are, however, by no means rare, most of these being entirely innocent lesions

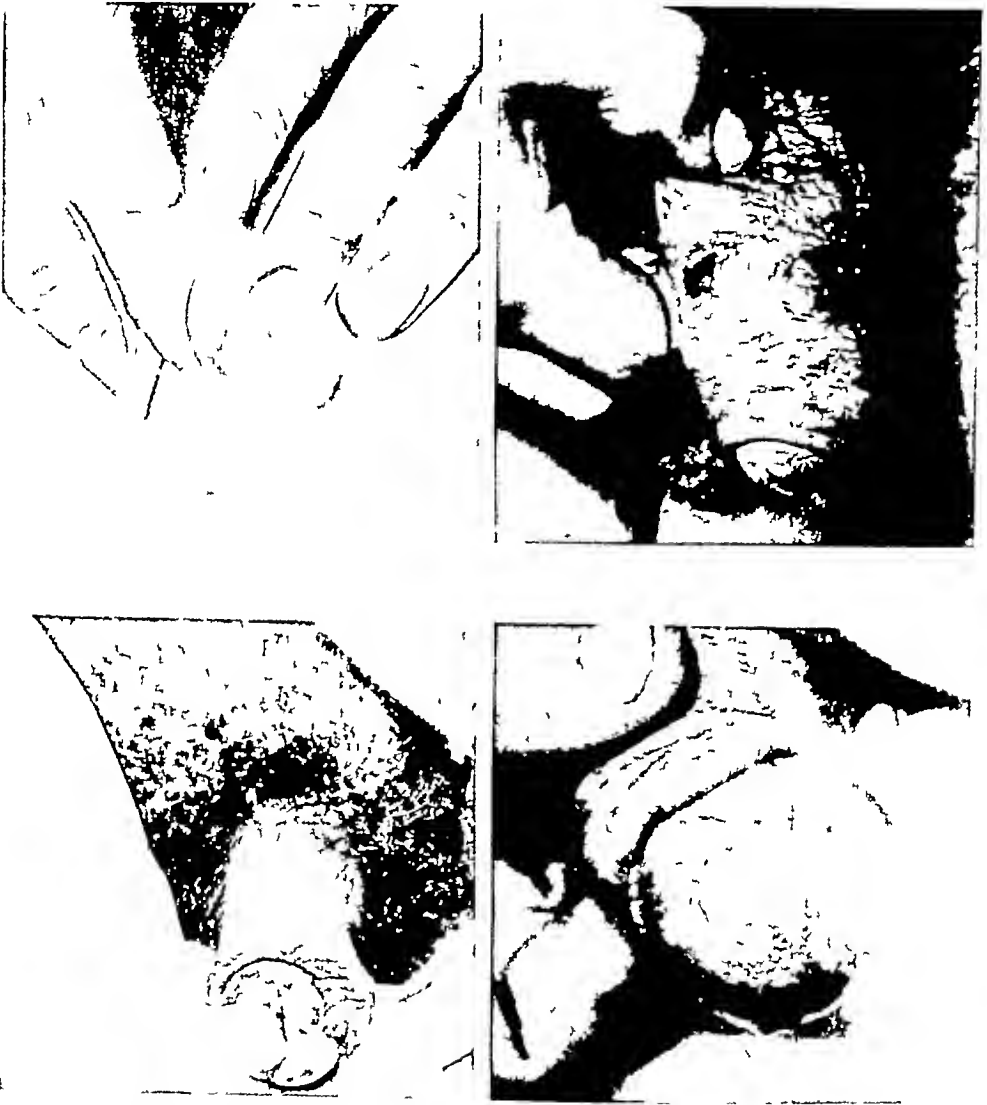


FIG 211—Various venereal ulcerations
 Upper left Chancre of coronary sulcus (Cook County Hospital case)
 Upper right Chancre of shaft of penis
 Lower left Destruction of glans by chancroid and other infection—chronic phagedenic ulcers
 Lower right Chancre (Hunterian)

THE GENITAL CHANCRE

Most of the chancres are found either on the glans penis or in and around the coronary sulcus (Fig 211) The margins of the prepuce, the region of the frenulum and the coronary sulcus (Fig 211) are the most common locations An appreciably large number are found at the meatus, although chancres on the dorsum or shaft (Fig 211) of the penis are not rare When suspicious lesions are

found in these two last named locations, they prove to be chancres in the vast majority of cases. The characteristic induration is most marked in lesions found on the inner layer of the prepuce just behind the sulcus. In women chancres are most common about the labia, infrequent on the cervix and are rare in the vagina.

CLASSIFICATION

Although the lesions appear in a variety of forms they can be classified in the main in relation to their infiltration and destruction of tissue into (a) eroded chancre (b) ulcerated chancre (c) indurated papule (d) Hunterian chancre (e) Parchment chancre (f) silver spot, (g) the multiple herpetiform chancre (h) the mixed chancre and chancroid.

(a) **The Eroded Chancre** Most of the genital chancres can be placed in this category. It appears at first, like an abrasion of the skin, the central portion of which becomes covered with a grayish membrane, is somewhat dusky at the edges and in about a week after its appearance the induration at the edges appears.

(b) **The Ulcerated Chancre** This is merely a deeper form of infiltration than the erosion, the center being ulcerated and may appear somewhat scooped out. The induration is marked and the edges are hard. The induration is often cartilaginous in consistency.

(c) **The Indurated Papule** This lesion differs from the above in that the skin is not broken, the lesion being elevated with an area of infiltration about it.

(d) **The Hunterian Chancre** This usually belongs to the type described above under ulcerated chancre. The characteristic of this lesion is its cartilaginous hardness, its location on the inner layer of the prepuce just behind the sulcus, presenting either an erosion or ulceration on its surface or practically no destruction of tissue. Although the Hunterian chancre is the classical lesion clinically, spirochetæ are found in these lesions with difficulty.

(e) **The Parchment Chancre**, found usually on the dorsum of the penis or on the frenulum, presents very little induration and but very little superficial destruction of the epidermis.

(f) **The Silver Spot**. This is a rare form, presents very little induration, no ulceration and is usually overlooked or wrongly diagnosed.

(g) **The Mixed Lesion**. A chancre may be combined with a chancroidal infection and because of the longer incubation period for the former the typical induration does not appear until later. These are the lesions which are often overlooked. A chancroid that does not heal up readily and presents definite induration later should be looked upon with suspicion.

EXTRAGENITAL CHANCRES

A primary lesion may appear anywhere on the body, many locations have been reported. Although most of the extragenital chancres are innocent lesions, i.e., nonvenereal, many are due however to sex perversions.

Chancre of the lip usually results from kissing an actively infected individual who has some mucous patches. An abrasion or "cold sore" favors localization of the spirochetæ.

Chancre of the tongue on the dorsum, near the tip or on the tip, is occasionally seen. Many varieties of chancre of the tonsil have been described—we have seen a few.

Chancre of the nipple is sometimes seen in wet nurses who have been nursing a syphilitic infant.

Chancre of the finger, as the result of infection at operation or during delivery or as the result of a bite, is the type seen in surgeons accidentally infected.

Anorectal chancres, often innocently acquired, are usually the result of infection due to perverse habits and are not uncommonly observed in large clinics and in institutions. Most of the extragenital lesions present few symptoms and are often overlooked.

THE CLINICAL CHARACTERISTICS OF THE CHANCRE

The one particular characteristic is the induration, which gives it the name, hard chancre. It has a smooth surface with sloping margins. In the typical ulcer, there is a cup-shaped depression. Some lesions are covered by a gray false membrane. The lesions usually bleed readily and when compressed, only a small amount of serum exudes. Another classical characteristic of the lesion is its painlessness. However, some are quite painful. The edge is often slightly reddened.

THE CLINICAL COURSE OF THE CHANCRE

The chancre begins as an area of erythema, it develops and extends in a more or less circular manner, so that in a few days there is some loss of the superficial epithelium and within a week or ten days, the typical induration can be felt. A typical lesion has now developed and does not progress much further. The typical lesion remains fully developed during the intermediate stage before the development of the secondary rash. With the onset of the eruption, the primary lesion begins to recede and within two or three months after the eruption appears, it has practically disappeared. Some primary lesions persist, the induration in some cases being present for a long time. This latter condition usually indicates insufficient treatment. With treatment, the initial lesion will disappear in a few weeks. The chancre usually does not leave any scar, in contradistinction to a chancroid.

Occasionally ulcerated lesions, especially those on the shaft of the penis, leave a definite permanent scar.

Lesions which develop after a relatively short incubation period, are usually more destructive. Some produce considerable destruction of the glans and even gangrene. In these cases, there is undoubtedly a mixed infection with some other spirochetæ or an associated gangrenous balanitis. The incubation period may be nine or ten days in these cases. Some chancres later develop into secondary lesions, mucous patches or condylomata. Inflammation due to irritation or secondary infection of the lesion, may alter its characteristic picture.

DIAGNOSIS OF THE CHANCRE

Every lesion of the penis should be suspected to be syphilitic until proven otherwise. By that is meant that repeated dark field examinations and follow-up

Wassermann blood tests should be made over a period of three months before ruling out syphilis. It does not, however, mean that antisyphilitic treatment should be administered for every suspicious lesion immediately when seen. A positive diagnosis should always be made before instituting treatment. The administration of salvarsan merely on suspicion or on general principles for genital lesions is wrong. As soon as treatment has been instituted, the picture is confused and it may be impossible to say whether or not the patient has syphilis.

A clear cut history of an incubation period of two weeks or more following a suspicious exposure should in itself, without taking into account the clinical characteristics of the lesion, make one seriously consider the possibility of a primary lesion.

Chancres are Usually Single. In a small percentage of cases they are multiple, but when so, all the lesions have developed at one time. They are not autoinoculable, i.e. a lesion of the penis in contact with the scrotum will not produce a chancre of the scrotum.

Chancroids, however, are Autoinoculable. The classical induration, sometimes marked as in Hunterian chancre, and in others, as in the superficial erosion, very little noticeable, can be felt distinctly by palpating the lesion.

The chancre is usually painless and often overlooked by the patient because of its apparent benignity.

Aside from the induration, the ulceration and erosion in its center, with its round sloping irregular edges, give the lesion its typical character.

During the incubation period before the appearance of the chancre (although unfortunately systemic infection has already begun with the exposure) there is no way of making a diagnosis. There are no symptoms during this period.

DARK FIELD EXAMINATION FOR SPIROCHETAE

The spirochetes, if present, can readily be diagnosed with the dark field (Plate IV). They are seen unstained, alive and motile. We have purposely not mentioned, as yet, the inguinal and generalized adenopathy and the general symptoms during the secondary incubation period, for we feel that the proper time to make a diagnosis of syphilis is with the beginning of the chancre, when there is very little systemic infection and there is yet a possibility of curing the individual. It requires very little diagnostic ability to wait until the Wassermann reaction becomes positive before instituting treatment. The diagnosis should be made by finding the spirochetes with the dark field illuminator before the Wassermann reaction is positive.

The newer type of dark field illuminator, replacing the Abbe condensor with an electric light below, has simplified the dark field examination for spirochetes pallida. With a little experience, the spirochetes can be readily seen when the proper technic is employed.

They can be found in ninety-five per cent of the cases.

The lesion should have no local treatment and should not be cauterized before making a dark field examination. If medication has been applied, it is best to have the patient soak the penis in warm water—no soap—for a day or two before presenting himself for examination. In most cases, however, the antiseptic can be washed off at once and the lesion squeezed and if spirochetes are present, they will be found. At least two negative dark fields at separate intervals are necessary.

before ruling out a hard chancre, for while the clinical characteristics may enable the experienced clinician to make a diagnosis, yet in the vast majority of cases, it is surprising how often an apparently simple lesion proves to be a primary lesion under the dark field

Most lesions have some superficial infection and ulceration on their surface. The latter should be thoroughly cleansed and the lesion dried before procuring the specimen. With the lesion held between the thumb and index finger, it should be squeezed gently and then quite firmly, until some serum appears on the surface. The first serum can be dried off and then the lesion squeezed again until some more appears. An ordinary microscopic slide is then placed in contact with the lesion and some of the serum collected. This is covered with a simple cover glass and spread out. It is well to make at least two, and preferably three slides. It is best not to make the lesion bleed because an excessive amount of blood corpuscles on the slide, interfere with the examination. An immersion oil lens is placed on the dark field already fitted into the microscope, and some of the serum is placed on the slide. The dark field is now centered and inspection begun.

The spirochetæ if present, are found within a very short while after inspection is begun. If after looking over the slide for two or three minutes, none are found, they are probably not present.

Spirochetæ are of different strains and different lengths.

The typical pale, thin, cork-screw winding along on its long axis is unmistakable. One must differentiate, however, the *Spirochaeta refringens* which may be the cause of some of the lesions or ulcerations of balanoposthitis and is sometimes found with the *Spirochaeta pallida*. Coarser *Spirochaeta dentium* can readily be distinguished. The *Spirochaeta refringens* is much coarser than the *pallida* and has fewer spirals.

The dark field picture of a chancroid which is most characteristic, merely shows numerous cocci throughout the field with here and there a few Ducrey bacilli.¹ In the hard chancre, there are relatively fewer pus organisms on the dark field.

In making the smear, thin slides which are not scratched, should be used. They must be well cleansed before using. In large clinics, it is advisable to have a microscope always ready with a dark field in place, for the frequent change from the Abbe condensor to the dark field, may interfere with the light and the centering of the instrument.

The lesion with little induration often shows numerous spirochetæ, whereas one with marked induration such as the Hunterian chancre, shows only a few and sometimes none can be found. The induration is the local protective mechanism against the spirochetæ. In ulcerated and eroded lesions, the serum should be taken from the edge of the lesion rather than from its center, in order to find the organisms.

Although we sometimes administer diphtheria antitoxin on suspicion based on clinical findings before a laboratory report is at hand, this same principle does not hold true for primary syphilis. Do not begin treatment merely on suspicion. An exception is the clinically classical Hunterian chancre in which no spirocheta can be found—treatment can be begun at once.

¹ See Plate III and Chapter 16

LOCATION OF THE CHANCRE

Lesions on the shaft, particularly the dorsum of the penis, although showing as a rule only superficial induration, are usually hard chancres

Mental chancres are quite frequently seen. They present a typical circular area of induration that is distinct and causes considerable lymph stasis, so that there is a brawny edema of the glans, and to some extent of the shaft of the penis

Intraurethral lesions found just at the edge or within the meatus, are in the vast majority of cases hard chancres. These intraurethral chancres are frequently seen and together with the mental chancres constitute 10 to 15 per cent of all genital chancres. A slight ulceration at the meatus in what apparently originally appeared to be a mild catarrhal urethritis calls for an immediate dark field examination. We have seen a number of cases where the lesion had been overlooked until later close inspection showed a slight ulceration with positive findings on the dark field. Cases that apparently simulate and are diagnosed as hyperacute gonorrhea with edema and phimosis should be considered suspicious if with all the local reaction, there is very little purulent or only a watery discharge. In a hyperacute gonorrhea, the discharge is profuse. Deeper intraurethral chancres occur but are rarely diagnosed. We have had the misfortune of seeing an acute syphilis develop in a patient who was under our care for gonorrhea. He had an undiagnosed intraurethral chancre the associated gonorrhea predominating in the clinical picture until the secondaries appeared. An intraurethral chancre three inches down the urethra, was later seen through the urethroscope

DIFFERENTIAL DIAGNOSIS

Chancroid. This is the most important lesion to differentiate. Chancroids are usually multiple (Fig. 212) are painful, appear as punched out lesions with irregular edges, are not inoculable and present an inflammatory or suppurative bubo in most cases. This will be discussed in the next chapter.

Granuloma, nearly always found in the negro, presents a gradually spreading localized chronic granulating area, that produces an extensive lesion in the groin, the lesion being entirely superficial.

Herpes. (Fig. 213) These lesions are common on the glans and shaft—often recur and while they can be readily differentiated by anyone with experience must always be considered. They are multiple, somewhat painful, superficial vesicles, which dry up in a few days and clear up readily with medication.

Scabies commonly attacks the genitalia. The associated findings and the typical lesions on the wrist and between the fingers enable one to differentiate this condition. The pyodermitis of scabies often leaves a permanent scar on the penis.

Chronic indolent and progressive ulcer of the penis—often very destructive—with loss of glans and sometimes shaft of penis, can usually be differentiated by negative findings and the negative results of antisyphilitic therapy.

Balanoposthitis is simply a superficial erosion with no induration and clears up after a few days of local treatment. Chronic balanoposthitis may be due to adhesions or a tight prepuce. Dark fluid examination often shows *Spiracheta refringens*.

Gumma is often diagnosed as a recurrent chancre or as a reinfection or a new infection, it must be considered in differentiation

Carcinoma² of the penis develops in older men and is of gradual onset Adenopathy is a late development

Periurethritis or folliculitis in gonorrhea at the frenulum Although the clinically classical Hunterian chancre can readily be diagnosed, we have seen cases of marked periurethral infiltration at the frenulum, in acute gonorrhea, diagnosed as hard chancre

Chancre of the vulva and external genitalia in the female presents no variation from that found in the male Lesions of the vagina are rare Primary lesions in the cervix usually are not recognized

Mixed chancre and chancroid is usually difficult to diagnose clinically



FIG 212—Multiple chancroids of the coronary sulcus (White and Martin) FIG 213—Herpes of the glans (White and Martin)

Only with repeated dark field examinations and a beginning positive Wassermann can a diagnosis be made in many cases

Secondary infection or phagedenic ulceration distorts the typical appearance of the lesion and makes even the dark field diagnosis difficult

The intermediate stage—period of secondary incubation During this period, the inguinal adenopathy develops and becomes prominent, the general symptoms of a subacute systemic infection present themselves and the generalized adenopathy gradually becomes noticeable This period is usually six to eight weeks and is followed by the appearance of the eruption

Inguinal Adenopathy—the syphilitic bubo This has its special characteristics as does the primary lesion The adenopathy is nearly always bilateral although usually more marked on the side draining the infected area of the chancre It develops slowly, produces no pain, does not suppurate unless there is a mixed infection or it is secondarily infected The bubo is freely movable under the skin—no periadenitis being present With the typical lesion and the associated bubo, the diagnosis of syphilis can readily be made In lesions of the lips, the submaxillary

² See Chapter 17

glands are first involved Puncture and aspiration of the bubo will sometimes show the presence of spirochetæ.

Generalized Adenopathy With the gradual dissemination of the spirochetæ throughout the body, all the deeper glands become involved Involvement of the deep glands such as the epitrochlears and popliteals indicates systemic infection It is for this reason that the finding of large epitrochlears in a general examination is generally considered as justifying a suspicion of syphilis, because this is the most common chronic systemic infection

The adenopathy is usually most marked in the cervical and postauricular glands although noted throughout the body When the adenopathy has fully developed the eruption usually begins to appear

Alterations in the Blood There is often a considerable degree of anemia during the intermediate stage The Wassermann reaction gradually becomes positive One or two weeks after the appearance of the primary lesion it shows itself as 1+ with each succeeding week the reaction becomes more intensified so that in three to six weeks the Wassermann is 4+

General constitutional symptoms of a low grade subacute infection are muscular and articular pains, pain in the long bones particularly of the legs backache Headaches are often quite marked usually occipital and are more marked at night Loss of weight with some cachexia and general malaise and depression are noted

The Eruption and the Secondary Manifestations. Only a few of the more marked manifestations will be mentioned and these will be covered only in a general manner Textbooks of dermatology and syphilis present this subject more fully In this chapter the attempt has only been made to describe syphilis as the urologist comes in contact with it in the dispensary, hospital and private practice during the primary and early secondary stages

As outlined in White and Martin the general features of a secondary syphilitic eruption are as follows

- 1 The lesions develop slowly are painless and do not itch
- 2 They are rounded in form and grouping and tend to scale
- 3 They are of a copper or raw ham color
- 4 They are symmetrical
- 5 They are polymorphous.
- 6 They are superficial
- 7 They yield to treatment.

Lesions appear early on the extremities, back and chest. The macular eruption is often overlooked The syphilitic roseola can usually be seen only in good daylight Exposure of the body to a current of air near an open window brings out the rash more distinctly With a suspicious lesion of a few weeks duration and an adenopathy the patient should be completely disrobed to examine carefully for the skin rash It is usually typical in appearance the round copper colored rash with superficial scaling when once seen stands out distinctly from other eruptions.

Eruptions on the scrotum and penis are quite common and present the typical round, symmetrical papules often moist, which may be the only lesions present. They are also typical in appearance.

The condylomata about the anus are moist papules, highly infectious and usually found in association with lesions on the scrotum

Mucous patches on the lips, mucous membrane of the mouth and on the tongue and tonsils, give a characteristic appearance which help establish the diagnosis. They appear as irregular markings, not elevated above the surrounding tissues and are somewhat grayish in color. The tongue and tonsils show either patches or erosions.

Alopecia This is not always present and the hair of the scalp alone, is usually affected. The hair comes out in irregular patches. This in a brief summary, gives the chief characteristics of the early secondary manifestations.

TREATMENT

Arsenic, in the form of the arsphenamines and bismuth, a heavy metal, are at present the mainstay of treatment. Mercury, which had for 4 centuries been practically the only drug used in the treatment of syphilis, has been relegated to a distinctly minor role within the past 15 years, and has been entirely discarded in most clinics. Potassium Iodide is still occasionally used as adjuvant treatment in the later manifestations. The following is an outline of treatment for early syphilis followed at Central Free Dispensary for the past 8 years under the direction of Dr. A. E. Skolnik.

FIVE COURSES

The treatment is divided into five courses without any rest periods in between. The duration of these five courses is approximately 26 months.

First Course As soon as a diagnosis is made the first course is begun—which consists of

- 1 At intervals of 3 days, 0.3 Gm., 0.45 Gm., 0.6 Gm. respectively of Neoarsphenamine
- 2 Then, at intervals of 5 days, 0.6 Gm. of Neoarsphenamine
- 3 Then, once a week, 0.45 Gm. Neoarsphenamine plus Bismuth

Eleven more Bismuth injections at weekly intervals until a total of 15 Bismuth injections are then given.

Second Course At the end of one week after the last Bismuth was given, the second course is begun. This consists of

- 1 At intervals of 3 days, 0.3 Gm., 0.45 Gm., 0.6 Gm., respectively of Neoarsphenamine
- 2 Then, at intervals of 5 days, 0.6 Gm. of Neoarsphenamine
- 3 Fifteen doses of Bismuth at intervals of one week

The third course is now started in the same manner and the same amount of treatment is given as in course two.

At the end of the third course the patient is given four weeks of Mercury rubs.

At the expiration of the four weeks the patient returns for the fourth course. Wassermann, physical examination, and urinalysis are made.

Course four follows

- 1 At intervals of 3 days 0.3 Gm 0.45 Gm 0.6 Gm., respectively of Neoarsphenamine
- 2 At intervals of 5 days 0.6 Gm of Neoarsphenamine
- 3 Fifteen doses of Bismuth Salicylate plus 15 minims Potassium Iodide

This again is followed by four weeks of Mercury rubs

Fifth Course The patient then returns for the fifth course of treatment which is identical with the fourth.

U S PUBLIC HEALTH SERVICE TREATMENT

Following is an outline of treatment of early syphilis recommended by the co-operative clinical group of the U S Public Health Service with a slight modification by J E Kemp The treatment consists of the use of Arsenic and Bismuth exclusively over a continuous period of 62 weeks

Arsenic can be given in any form Neo-Salvarsan and Mapharsen we believe are the most desirable Bismuth can be given either as soluble or insoluble, the latter is preferred.

Either Arsenic or Bismuth alone is used at certain periods Both of the drugs are given together weekly at intervals of 3 to 4 days during most of this period.

TREATMENT FOR EARLY SYPHILIS

First week	Arsphenamine	32nd week	Arsphenamine
5 days later	Arsphenamine	33rd week	Arsphenamine
2nd week	Arsphenamine	34th week	Arsphenamine
3rd week	Arsphenamine Bismuth	35th week	Arsphenamine Bismuth
4th week	Arsphenamine Bismuth	36th week	Arsphenamine Bismuth
5th week	Arsphenamine Bismuth	37th week	Bismuth
6th week	Arsphenamine Bismuth	38th week	Bismuth
7th week	Arsphenamine Bismuth	39th week	Bismuth
8th week	Arsphenamine Bismuth	40th week	Bismuth
9th week	Arsphenamine	41st week	Arsphenamine Bismuth
10th week	Arsphenamine	42nd week	Arsphenamine Bismuth
11th week	Arsphenamine	43rd week	Arsphenamine
12th week	Arsphenamine	44th week	Arsphenamine
13th week		45th week	Arsphenamine Bismuth
14th week	Bismuth	46th week	Arsphenamine Bismuth
15th week	Bismuth	47th week	Bismuth
16th week	Bismuth	48th week	Bismuth
17th week	Arsphenamine Bismuth	49th week	Bismuth
18th week	Arsphenamine Bismuth	50th week	Bismuth
19th week	Arsphenamine	51st week	Arsphenamine Bismuth
20th week	Arsphenamine	52nd week	Arsphenamine Bismuth
21st week	Arsphenamine	53rd week	Arsphenamine
22nd week	Arsphenamine	54th week	Arsphenamine
23rd week	Arsphenamine Bismuth	55th week	Arsphenamine Bismuth
24th week	Arsphenamine Bismuth	56th week	Arsphenamine Bismuth
25th week	Bismuth	57th week	Bismuth
26th week	Bismuth	58th week	Bismuth
27th week	Bismuth	59th week	Bismuth
28th week	Bismuth	60th week	Bismuth
29th week	Arsphenamine Bismuth	61st week	Bismuth
30th week	Arsphenamine Bismuth	62nd week	Bismuth
31st week	Arsphenamine		

Spinal fluid examination.

CHAPTER 16

CHANCROID, LYMPHOPATHIA VENEREUM AND OTHER VENEREAL ULCERATIONS

CHANCROID

TYPES OF LESIONS
COMPLICATIONS OF CHANCROIDS
DIAGNOSIS OF CHANCROID
PROGNOSIS

TREATMENT
GRANULOMA INGUINALE
LYMPHOPATHIA VENEREUM
THE TREI TEST
OTHER VENEREAL ULCERATIONS

CHANCROID

This is the third¹ of the well-known venereal diseases. It is purely a local infection with some extension to and involvement of the inguinal glands. However, it often masks the initial lesion of syphilis which may be associated. It produces no systemic manifestations, but in the severe ulcerative forms may



FIG. 214.—The photograph on the left shows an extensive chancroidal ulceration of the prepuce. The photograph on the right shows a chancroidal ulceration of the dorsum of the glans penis and of the prepuce when latter is retracted.

cause considerable local destruction of tissue. It has apparently existed since prehistoric times. It is termed soft chancre in contradistinction to the hard chancre of syphilis. An inflammatory bubo, often becoming suppurative, develops in over 30 per cent of the cases, so that it can be considered as part of the disease entity (Figs. 212 and 214).

Etiology. Chancroids are usually associated with uncleanness and filth, most of the cases being seen in dispensary patients. The initial lesion of syphilis is more common in private practice than is the soft chancre, whereas the opposite is the case in dispensary practice.

The Ducrey bacillus (Plate III) has been definitely proven to be the

¹ The other two are gonorrhea and syphilis.

etiologic factor. It is difficult to find in smears made from the lesion because of the large number of associated ordinary pus organisms present. The Ducrey bacillus is found only rarely in the suppurative bubo.

Chancroid may, in rare cases, be due to infection from contaminated towels or other objects. The lesions, however, are practically always found on the genitalia and are transmitted through sexual contact.

The Ducrey bacillus (Plate III) is a streptobacillus, dumbbell shaped, thick and rounded or squared at the edges. It groups in parallel chains and stains well with the ordinary dyes.

An abrasion of the skin or mucous membrane is usually necessary for a lesion to develop following contact. Chancroids are contagious and autoinoculable. The latter is quite characteristic of the lesion. A lesion may appear at the point of contact of the chancroid with the thigh or lesions may develop later on the glans after having first appeared on the prepuce. A second lesion may appear three or four days after the first and a third develop later. All need not appear at the same time whereas the hard chancre is not autoinoculable, all lesions. If there be more than one appearing at the same time.

Pathology of Lesion. The ulcer is made up of a small round cell infiltrate which while not deep extends for some distance beyond the borders of the lesion which is often undermined. This extension beyond the superficial area of the lesion requires cauterization of an area larger than the lesion in order to destroy the infection.

Location of the Lesion. Chancroid in the male is most common in the coronary sulcus especially in the little pocket on each side of the frenulum. In the female it is usually seen about the vulva.

In the male, chancroids are also common on the inner surface of the prepuce and on the glans. They commonly form a rosette at the junction of the mucosa and skin of prepuce. Beginning often as a single ulcer they rapidly become multiple and may extend to the anus and thigh by autoinoculation.

The contagious nature of the lesion often changes the incised suppurative bubo into a chancroidal ulceration of its edges. The dorsal slit that occasionally must be done for the associated phimosis (Fig 215) often develops into a chancroidal (Fig 214) ulceration for the same reason. Never do a circumcision in the presence of a chancroid because the danger of developing a chancroidal circular ulceration of the edges of the wound is great (Fig 214).

Incubation Period. The incubation period varies as a rule from three to seven days, often less than three days rarely later than a week.

Onset. The lesion develops rapidly first as a reddish blush, surrounding a pin-point abrasion.

This soon spreads and changes into an inflamed areola, becoming a typical ulcer within forty-eight hours.

THE CHANCROIDAL ULCER. The typical lesion is a round ulcer with undermined or perpendicular edges (Fig 214). The ulcer appears punched out, irregular is covered by a membrane and has some suppuration on its surface. It is usually painful sometimes very intensely so it bleeds readily and gives off abundant serum when squeezed.

The shape of the lesion depends upon anatomical peculiarities and the shape of the eroded surface. The so-called "hair-cut" is usually merely a linear chancroid. At the frenulum, the lesion is long and irregularly shaped, usually eroding through the frenulum and often destroying it. Chancroids are rarely found at the meatus or intraurethrally.

Course of the Lesion The uncomplicated sore clears up within two or three weeks and often sooner, with appropriate treatment. The lesion heals by cicatrization from the edges toward the center.

TYPES OF LESIONS

The Simple Chancroid This usually appears in the form of a number of superficial punched out small ulcers about the corona, which do ulcerate and are only slightly painful. This type of lesion responds readily to frequent bathing and mild local antiseptics. Bubo does not develop.

The Inflammatory Chancroid The lesions at the preputial orifice are constantly irritated and infected and take a long time to clean up. The lesions on the inside of the prepuce and on the glans often produce much inflammatory reaction with edema of the prepuce and the commonly associated phimosis. These lesions together with those of the glans do not, however, cause any degree of ulceration. Paraphimosis often results after retraction of the edematous prepuce.

The Ulcerative Chancroid This may occur on the glans, but is usually found on the coronary sulcus and often at the frenulum. It produces a deep punched out ulcer that is slow in healing, may produce some destruction of the glans or of the frenulum and usually leaves a deep scar.

Mixed Lesions This begins first as a chancroid and after three or four weeks when the chancre has incubated, it develops some induration and persists. These lesions are difficult to diagnose and it is because of these lesions and the inability to be certain from clinical evidence that a certain lesion is merely a chancroid, that repeated dark fields and prolonged observation is necessary, to make the diagnosis.

COMPLICATIONS OF CHANCROIDS

Phimosis (Fig. 215) The phimosis develops in inflamed chancroids of the prepuce within a few days. The edema is so marked at times, that the glans can not be seen and the prepuce can be only slightly retracted. There is considerable pain, and a profuse discharge is often present that may appear to the patient, and sometimes the clinician, as coming from the urethra.

This edema does not respond to heat and bathing in many cases, and for the purpose of relieving the edema and the tension of the phimosis, and also to be able to treat the lesion, a dorsal slit³ must be resorted to. Paraphimosis will occur if the prepuce is retracted, or if it be short. A not uncommon experience is to find that a paraphimosis follows the retraction of the phimotic prepuce, it being sometimes impossible to pull the prepuce forward again. In these cases, a dorsal slit³ is immediately indicated. In the cases with phimosis, there is no interference with the urinary stream but this may occasionally occur with a paraphimosis. The presence of the lesions can readily be diagnosed by pal-

³ See Chapter 48

pation over the phimotic prepuce. They can be distinctly felt and outlined. They are usually somewhat indurated, elevated and quite painful.

Phagedenic Chancroid. This may produce partial or complete destruction of the glands. It is not uncommon in dispensary practice to see patients who have evidence of partial or almost complete destruction of the glans body of the penis from a previous chancroid. With these lesions there usually develops considerable scar formation producing a marked fibrosis at the meatus and stricture. In the phagedenic lesions, gangrene may develop because of interference with the circulation and there may be more or less complete destruction of the penis. The gangrene usually develops in weak and cachectic individuals and is due to infection by other organisms.

Lymphangitis. Involvement of the lymph vessels (Fig. 54) such as the dorsal lymph cord is rare even in the presence of a bubo. Suppuration may occasionally develop in the dorsal lymph cord.



FIG. 215.—Chancroidal phimosis. Secondary chancroids about the preputial orifice (White and Martin.)

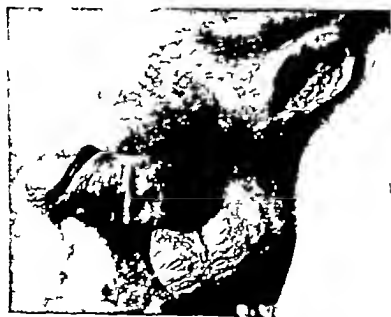


FIG. 216.—Chancroidal bubo (White and Martin.)

The Chancroidal Bubo. This occurs so commonly that it can be considered as a part of the clinical picture. Inguinal adenitis develops in nearly 30 per cent of the cases. It is practically always a periadenitis because whether or not suppuration develops the entire mass or chain of glands is matted together and adherent to the surrounding tissue. In from 30 to 50 per cent

of the lymphadenitis cases, the glands break down and suppurate. The chain of glands immediately above or below Poupart's ligament (Fig 216) may alone be involved. In some cases, there develops a slight painful swelling with some redness and matting together of the mass to the skin. This persists for a week or ten days and then gradually subsides without abscess formation. Others are quite painful and result in a large swelling which is tender and, after a few days, shows evidence of fluctuation and abscess formation. Others do not become very large or tender, but soften and suppurate early. The bubo is usually bilateral but more marked, as a rule, on one side, the other side showing a slight adenitis, which does not break down. The adenitis usually develops on the side into which the lesion of the penis drains. Bilateral suppurative bubo, however, is quite common. One side breaks down before the other. When an abscess has developed there is some relief of tension with lessening of pain. The type of bubo which does not suppurate is also often bilateral. Some cases of chancroidal bubo, even after being incised, persist as large hard infiltrated masses for many months before finally clearing up. In other cases, these hard infiltrated glands persist and their operative removal may be necessary. In some cases, complete lymphatic blockage may develop in these chronic infiltrated inguinal glands with marked swelling over the pubis associated with edema of the scrotum and penis which persists for months, most of these are probably undiagnosed cases of Lymphopathia venereum.

DIAGNOSIS OF CHANCROID

The soft chancre presents certain diagnostic features. The incubation period is two to five days, the lesions are multiple, they form ragged punched out lesions, the ulcers are undermined and covered with a grayish membrane. The lesions are not indurated, they are usually painful. There is an associated inflammatory bubo in a large percentage of cases. This bubo often suppurates. The lesions spread by contact inoculation, and do not all develop simultaneously. The Frei test will differentiate it from Lymphopathia Venereum.

Herpes and simple ulcer of the penis may simulate a chancroid but can readily be distinguished. Superficial ulcerations of a balanoposthitis do not give rise to much difficulty in differential diagnosis. The most important differentiation to make, however, is between soft and hard chancre. The clinical picture of both is quite distinct, but one can never rule out a primary lesion without repeated dark fields and observation of the case over a period of four to eight weeks.

PROGNOSIS

The simple chancroidal ulcer clears up in a week or ten days without much care other than cleanliness. The inflammatory and phagedenic lesion may persist five to six weeks and often many months.

TREATMENT

Prophylaxis Thorough washing with soap and water after a suspicious exposure, will usually prevent a chancroid. Soap and water are also very destructive to the *Spirochaeta pallida*. The external application of a 33 to 50 per cent

calomel ointment immediately after exposure following the washing of the parts, is an excellent prophylactic against both hard and soft chancre

Cauterization With the recognition of the lesion cauterization of the lesion and some of the tissues around it gives the most satisfactory results

Cauterization is of most value when applied a few days after the lesion appears but it is of value even in the presence of a suppurative bubo Burning the lesion will not dam up lymphatic drainage to any extent, thereby possibly promoting the development of a bubo The following procedure for cauterization has proven satisfactory application of (1) 95 per cent phenol followed by (2) 95 per cent alcohol on an applicator this followed by (3) C P nitric acid A 15 or 20 per cent copper sulphate solution is very satisfactory but is penetrating and causes pain for a considerable length of time All of the lesions should be cauterized at one sitting and this can be repeated at intervals of one week until the lesion has healed Cauterization should extend a little beyond the margin of the lesion because the chancroid is an undermining lesion In the interval between cauterizations the patient is instructed to keep the lesion clean by bathing and soaking Application of a 1 per cent copper sulphate solution three to four times a day helps to prevent the spread of the lesion

After the lesion is under control an ointment consisting of iodoform and balsam of Peru in petrolatum, aids in hastening the cleaning up of the lesion and the healing Iodoform 6 balsam Peru 12 petrolat q.s ad 100 applied two or three times daily

Incision. The phymotic prepuce should be incised by means of a dorsal slit Do not attempt a circumcision until the chancroid is entirely healed

When the bubo fluctuates incision is indicated but not before this Ichthyol 10 per cent is a good application for the inflammatory suppurative bubo Hot applications to relieve the pain or to hasten formation of the abscess should be employed routinely Favorable reports have appeared concerning the use of tartar emetic intravenously in the treatment of chancroids Although we have seen some successful results in the main the results are not convincing

GRANULOMA INGUINALE

This is a noninflammatory disease (Fig 217) involving chiefly the inguinal region but also the prepuce perineum or vulva the infection being limited to the skin. Although this disease has been known in the tropics for many years it has only been noted in this country during the last decade and in the northern states during the last few years

Etiology It is a disease which occurs almost exclusively in negroes It is rarely seen in white men. Males and females are both infrequently affected It is more common in the South and the tropics than in the northern climates However within the last few years every clinician with a large dispensary practice in gynecology and urology has seen a relatively large number of these cases. Although there is still some dispute as to the etiologic factor the Donovan bodies which are not always demonstrable are recognized generally as the cause The organism is a Gram negative non motile encapsulated bacillus The Wright Giemsa stain is the best for these organisms. The latter appear as small round pinkish bodies with a dark blue nucleus—the pinkish outline is due to its

capsule The organisms are found in the cytoplasm of large mononuclear cells They present characteristic growths on ordinary culture media

Pathology The lesion consists of proliferating granulation tissue which destroys the skin, but involves the subcutaneous tissues very slightly The base of the lesion consists of dense hyaline connective tissue with a superficial cellular area composed of many endothelial cells and a small number of leucocytes, together with some lymphocytes The lesion extends somewhat farther than its superficial margins would indicate

Symptoms and Course The lesion starts as a small papule which begins to exude and then ruptures It produces a little pain and soon begins to extend This extension is interfered with very little by local treatment and within a variable period, usually three to four months, has covered a considerable area



FIG 217.—Granuloma inguinale involving scrotum and adjacent portion of thigh

The edges are apparently healthy, elevated and covered by normal skin The lesions have irregular margins and their surface produces some slight exudation Beginning in the inguinal region over Poupart's ligament the lesion may extend upward for a short distance as far as the iliac spine but usually extends downward, following the fold of the thigh and involving the perineum almost to the anus As it progresses, it tends to heal, in the areas first affected, so that one may see a linear scar with areas of granulations lower down The granuloma may persist for months and years after it has fully developed, may heal in spots but usually flares up at intervals Upon healing it leaves a linear scar extending along the groin and down the inner fold of the thigh This particular extension and appearance is diagnostic

After having apparently healed with or without treatment, the granuloma may recur over the scarred area Because of its location it causes considerable

inconvenience and some pain and difficulty in walking. The lesion is usually unilateral but is sometimes bilateral. The lesions on the prepuce do not give the same picture or extend far. Those on the scrotum and perineum do not produce a linear granulation but cover a larger area. The labia in the female are often involved.

Diagnosis. When a typical granuloma inguinale has once been seen it is difficult to overlook others. The chronic superficial granulation area in the negro extending the entire length of the groin and inner fold of thigh with elevated irregular rolled up edges is diagnostic. The small lesions on the prepuce or on the coronary sulcus are often difficult to diagnose. Lymphopathia venereum, chancroid and chronic genital ulcers are often difficult to differentiate. Repeated dark field examinations and follow up Wassermanns will differentiate. There can be no doubt that some of the stubborn chancroids are really granulomas and that many of the chronic genital ulcerations not definitely classified also have the same etiologic basis. A granuloma and chancroid may be associated in the same lesion.

Treatment. Antimony and potassium tartrate (tartar emetic) intravenously has proven of value in the treatment of these lesions. While acclaimed generally as a specific, there are many cases of granuloma that do not respond to tartar emetic. Others respond brilliantly. A lesion that has persisted for many months will cease to be painful after the first injections and will clear up within a few weeks after additional injections. Five cc. of 1 per cent tartar emetic is the standard dose. Some patients present severe gastro-intestinal symptoms after the use of tartar emetic.

Mercurochrome applied locally daily is of value and has cleared up a few cases in which tartar emetic could not be given because the patients either reacted severely after the use of tartar emetic or the lesion did not respond to its use.

LYMPHOPATHIA VENEREUM

Lymphopathia Venereum (Fig. 218) is a definite clinical entity of venereal origin. It is a disease which attacks the lymph channels and nodes and although it had been considered a tropical disease in the past it is now frequently recognized and seen in nearly all parts of this country. It is most common in the male preponderantly among the colored but also occurs in the white and in the latter is usually the result of cohabiting with the colored. This disease has been recognized generally only during the past decade. Many conditions diagnosed previously as phagedenic ulcers, long standing chancroidal infections, idiopathic and climatic bubo and granuloma inguinale have been found to be Lymphopathia venereum. Chronic inguinal adenitis which frequently progresses to sinuses and suppuration has been described in the past under many names. These were cases of Lympho-granuloma inguinale.

The causative agent is unknown, but is evidently a filterable virus transmitted through coitus. The onset is characterized by a small initial lesion on the genitalia which is transitory and heals rapidly. The patient is usually unaware of the initial lesion, the first symptoms presenting themselves as a bubo. In the male the adenopathy is usually localized to the inguinal region. In the female

The etiologic factor in published cases is unnatural sexual relations and the moistening of the labia or penis with saliva. The spirochaetae and bacilli, normally present in the mouth around the margin of the gum and teeth and which, upon becoming pathologic, are the etiologic factors for Noma and Vincent's angina and lung abscess, are the same organisms found in the cases just described. In some cases there is considerable destruction of tissue and intense febrile reaction. Treatment with hydrogen peroxide, two per cent, clears up the condition rapidly, because the organisms are anaerobic.

Inguinal Adenitis The inguinal glands consist of two sets of glands, superficial and deep. The superficial set of glands are fourteen to fifteen in number (Fig 61), divided into three groups, all in relation to the saphenous opening. One group is above, another external to and a third below the saphenous opening. These lie immediately beneath the skin and either above or below Poupart's ligament.

The deep femoral glands, four or five in number, form an independent chain, extend along the femoral vein and are situated near the saphenous opening beneath the superficial glands. The deeper glands are usually not affected except in chronic adenitis or in infections of the lower extremities. Any infection below the level of the iliac spines, either in front or back, may be complicated by an inguinal adenitis. Infection of the deep structures in the true pelvis will not result in an inguinal adenitis but will cause an adenitis of the deep iliac nodes. Although the venereal diseases, chancroid, chancre and to a lesser degree, gonorrhea, are the most common causes, many other conditions may be the etiologic factors.

Fissure in ano, infected hemorrhoids, infections of the toes or lower extremities, folliculitis of the skin of the penis and balanoposthitis, may be followed by inguinal adenitis. In fact, as stated before, any superficial infection or irritation below the level of the iliac spines may be the primary focus. Wounds, furunculosis, intertrigo, eczema and chafing may also be the causes.

CHRONIC FORM

There is a chronic form of inguinal adenitis or bubo due either to tuberculosis, metastases from malignant growths of the penis or scrotum, Hodgkin's disease or elephantiasis. The syphilitic bubo is classed among these although it can be classed under the acute. Some chancroidal bubos become chronic. The acute bubo merely presents a localized swelling of one or both sides with abscess formation. The inflammatory virulent bubo, usually associated with chancroid, but often due to other causes, presents a marked periadenitis and inflammatory reaction, with pain, and later, suppuration.

The chancroidal bubo has been described. The syphilitic bubo is usually bilateral, somewhat indurated, hard and painless.

It may be associated with a chancroidal infection or be secondarily infected. A slight fluctuation may be noticeable, due to associated infection. Incision of the syphilitic bubo shows a mass of granulation tissue which bleeds somewhat readily and which has a distinctive appearance that is almost diagnostic.

Inguinal adenitis, unilateral usually, and sometimes bilateral, is a frequent occurrence during the first ten days or two weeks of an acute gonorrhea. It is merely a simple adenitis and does not suppurate. It recedes in a few days after the application of heat. The attention of the patient is attracted to it by the slight pain and tenderness in the groin.

Suppurative bubo is sometimes seen in chronic gonorrhea. They are due to secondary infecting organisms rather than to the gonococcus. These cases are not rare in dispensary and clinic practice.

The chronic bubo may be secondary to a neoplasm such as tumor of penis. Occasionally one may see tuberculosis of the inguinal glands with caseation and suppuration. Filariasis as seen in the tropics will produce a soft boggy swelling of the inguinal glands that is often reducible and may be mistaken for hernia.

Hodgkin's disease and syphilis may produce an inguinal adenitis in association with a generalized adenopathy.

Inguinal adenitis seen among our troops during the World War was due to irritation and slight infection of the toes from ill fitting shoes, the cause of the adenitis being often overlooked.

Treatment. Many of the cases of inflammatory bubo with periadenitis do not suppurate. Rest in bed and application of ichthyol ointment often helps to prevent suppuration.

DO NOT INCISE A BUBO UNTIL DEFINITE FLUCTUATION HAS APPEARED. Incision and drainage as for any abscess, is the mode of treatment for a suppurative bubo. Hot applications are excellent in hastening suppuration. Injections of iodoform into a bubo has been tried but is not of much help. Aspiration of the abscess and injecting the iodoform sometimes saves an incision. Enucleation of the glands in chronic hyperplastic adenitis (adenectomy) is at times unavoidable. This is a formidable procedure because of the relation of the glands to the saphenous and femoral veins.

Trichomonas Vaginalis Infestation in the Male.⁴ *Trichomonas vaginalis* infestation is a frequent occurrence in women and from this source is transferred to the male during coitus. Infestation of the male genito-urinary tract may take place without symptoms or signs or a urethral discharge may be present within 24 hours. If the infestation is of long standing it is present in the prostate gland. This has been frequently reported. It is often associated with urethritis due to staphylococcus streptococcus or *B. Coli* infection. Symptoms are not marked and are chiefly due to the associated bacterial infection. Irrigation and prostatic massage are of some value in treatment but must be carried out over a long period. Heat applied to the perineum in the form of diathermy together with bladder irrigation with 1:3000 acriflavin is the best routine treatment. Treatment by diathermy is the method of choice.

PART THREE

MALE GENITALIA

CHAPTER	PAGE
17 PENIS AND URETHRA	275
18 PROSTATE AND OTHER BLADDER NECK OBSTRUCTIONS	301
19 SEMINAL VESICLES	354
20 VAS DEFERENS SPERMATIC CORD EPIDIDYMIIS	373
21 TESTIS AND SCROTUM	402
22 STERILITY IN THE MALE	428
23 DISTURBANCES OF SEX IN THE MALE	443

ORIENTATION

The male urethra, as the result of imperfect development, instead of ending in the middle of the glans penis, may end proximal to this point. If the abnormal ending is on the upper side of the penis, the condition is termed epispadias, whereas if on the lower side, the malformation is termed hypospadias. The latter is, by far, more frequently observed, the distal orifice of the urethra being found at any point between the perineum and glans penis. These anomalies can both be corrected by plastic operations which will be described later. Injuries of the urethra occur most often in front of or between the layers of the triangular ligament, i.e., close to the bulbomembranous portion of the urethra. After a blow or fall on the perineal region, the possibility of a rupture of the urethra must be constantly kept in mind, because of the danger of extravasation of urine, which if it takes place in front of the triangular ligament will be found to infiltrate the subcutaneous tissues of the perineum, scrotum and anterior abdominal wall. If the extravasation of urine occurs behind the triangular ligament, the urine escapes into the cellular tissue around the bladder. A similar condition occurs as a complication of stricture of the urethra either following trauma or, more commonly gonorrhea, as shown in Figure 48. Instead of an extravasation of urine following urethral injury, the chief clinical sign may be bleeding from the external meatus or an enormous hemorrhage into the soft tissues of the scrotum or perineum or both. Although malignant tumors of the urethra are comparatively rare, the opposite is true of those of the penis, the most commonly observed tumor being a carcinoma of the squamous celled type at or near the glans penis, so that amputation is possible unless extensive involvement of the regional lymph nodes has already taken place.

The term prostatic hypertrophy is a misnomer. The normal prostate although frequently infected as a complication of gonorrhea, does not undergo a hypertrophy to give rise to the enlarged prostate which is the most common cause of obstruction of the bladder neck after the age of fifty. The so-called hypertrophied prostate has its origin in a different set of glands from those which form the prostate in the embryo. These later glandular acini are displaced peripherally by the glands from which the prostatic adenoma of middle age arises so that the compressed tissue which forms the "false" capsule of the prostatic adenoma really represents the normal organ of early life. In some cases, estimated at twenty per cent, the glandular proliferation takes place in an atypical manner to form an adenocarcinoma.

The role of the seminal vesicles as a reservoir for the semen has been referred to in the chapter on anatomy, but the importance of these structures in explaining the frequency of recurrence of gonorrheal infection is just beginning to be appreciated. The seminal duct on each side of the body which begins as the ejaculatory duct at the verumontanum and ends in the epididymis is a continuous structure, so that any type of infection whether nontuberculous or tuberculous can be easily transmitted in a centrifugal or centripetal direction.

The human testis like the epididymis is a very complex structure. Although infection of the testis is relatively infrequent, tumors are common. Many of these are of embryonal origin and the prognosis and results of irradiation treatment can be judged by the amount of Prolan A in the urine.

Sterility and disturbance of sex in the male are subjects with which the student must be familiar, because they constitute such a large proportion of the complaints of patients who seek the advice of the urologist.

CHAPTER 17

PENIS AND URETHRA

ANOMALIES OF MALFORMATIONS
ANOMALIES OF THE PENIS
ANOMALIES OF THE PREPUCE
ANOMALIES OF THE URETHRA
INJURIES OF THE PENIS AND URETHRA
INJURIES OF THE PENIS
INJURIES OF THE URETHRA
FISTULA, FOREIGN BODIES AND CALCULI OF THE URETHRA

DISEASES
DISEASES OF THE PENIS
CUTANEOUS AFFECTIONS
INFLAMMATION
GANGRENE
INDURATION
BENIGN TUMORS
CARCINOMA
SARCOMA
DISEASES OF THE URETHRA

ANOMALIES AND MALFORMATIONS

ANOMALIES OF THE PENIS

Anomalies of the penis are relatively rare. Extensive anomalies are usually associated with those of the other genito-urinary organs and are incompatible with life. Minor variations from the normal variations in size and incurvations are frequently seen. The penis may be absent. In some cases it may be adherent to the scrotum and twisted or there may be a cleft penis.

Double Penis. This condition is extremely rare (Fig 220). Those cases reported have usually been associated with a double bladder and other gross anomalies of the genito-urinary organs. The anomaly may be considered as analogous to double vagina and double uterus which represent some forms of arrest of phylogenetic development.

Absence of Penis. Absence of the penis as the result of surgical removal, trauma, gangrene or ulceration is not a rarity. Only a few cases of congenital absence have been reported and these have been associated with otherwise normal external genitalia, the scrotum being developed and the testicles in the scrotal sac.

Concealed Penis and Apparent Absence. In the cases of concealed penis a rudimentary penis is usually found hidden beneath the overhanging pubic fat. The penis may lie buried under the skin of the abdomen, thigh or scrotum and without its normal integument. In stout individuals, and particularly those who have a large scrotal hernia or large hydrocele, the penis may be covered to such a marked degree by the mass that it is difficult or impossible.

Torsion of the penis is often associated with an epispadias or hypospadias but may be present without urethral deformity, the penis being entirely twisted upon itself.



FIG 220.—Double penis. This patient was shown at the October 1926 meeting of the German Urological Society by the head of the Urological Department of the University of Constantinople to whom we are indebted for permission to reproduce this rare anomaly here.

Megalopenis is often found in congenital imbeciles and also in precocious puberty. In dwarfs, the penis may reach a size larger than that of a normal man.

Micropenis Arrested growth of the penis is quite common, there being, however, a wide range in variation from the normal.

Adherent Penis The penis may be adherent to the scrotal sac. In some men, the median raphe of the scrotum often continues almost to the prepuce, making it appear that the penis is much smaller than its actual size and often interferes with coitus.

Cleft Penis A few cases have been reported with a dorsal sulcus and a ventral slit for the urethra. The upper one probably represents the remnant of the separate seminal duct found in lower vertebrates.

Incurvations of the penis, interfering with coitus and requiring surgical intervention, have been reported. Minor degrees of incurvation are not uncommon.

ANOMALIES OF THE PREPUCE

The prepuce may be absent or incompletely developed. In hypospadias it consists of an upper flap only, the lower half being absent. The opposite condition is found in epispadias with a prepuce of only the lower half.

Congenital Phimosis The extreme degrees of phimosis in which the preputial orifice is almost pin-point in size, and through which the meatus can scarcely be seen, are not rare. Some go along for many years without any attempt at relief. In urinating the prepuce usually balloons out first and then a narrow stream appears. These cases are usually associated with adhesions, although one is often surprised during circumcision not to find adhesions present. Variations from the extreme condition are seen and there are many persons who have never been able to retract the prepuce over the glans.

Preputial cysts and cysts of the raphe are due to persistence of some minute embryonic rests of the lower urinary tract and are common, particularly so at the prepuce.

ANOMALIES OF THE URETHRA

Congenital Stenosis of the Meatus This is not uncommon, but operative interference is rarely necessary to enlarge the orifice by meatotomy (Chap. 48) unless it interferes with urination, passage of an instrument or is needed in the treatment of a chronic urethritis.

Double Urethra

INCIDENCE Only 38 cases have been reported according to De Berne-Lagarde (*Arch. Mal. des Reins*, 1932, 7, 39) including one of his own.

VARIETIES Chauvin (*Jour. d'Urol.* 1927, 23, 289) grouped the reported cases as follows:

(a) Complete reduplication, i.e. the proximal end opens into the bladder (A of Fig. 221)

(b) A canal lying below the true urethra which ends blindly at its proximal i.e. nearest bladder, extremity (B of Fig. 221)

(c) The accessory canal lies above the true urethra but ends blindly as in the preceding type (C of Fig. 221)

(d) The accessory urethra ends in the true urethra (D of Fig. 221)

(e) The accessory urethra opens at the penoscrotal junction (E of Fig. 221)

De Berne-Lagarde and R. Meyer only consider the cases as being termed double urethra in which the accessory canal lies above the true urethra.

CLINICAL ASPECTS In the type in which the accessory canal does not communicate with the urethra (C of Fig 221), the patient is unaware of the existence of this anomaly, unless a gonorrheal infection occurs. Such a case was reported by Legueu in 1931. If the accessory canal opens into the bladder proximal to the sphincter urine passes through both urethrae. If the proximal opening is distal to the internal sphincter incontinence is the chief symptom. Such cases were reported by Lebrun, Rona and Mackenzie.

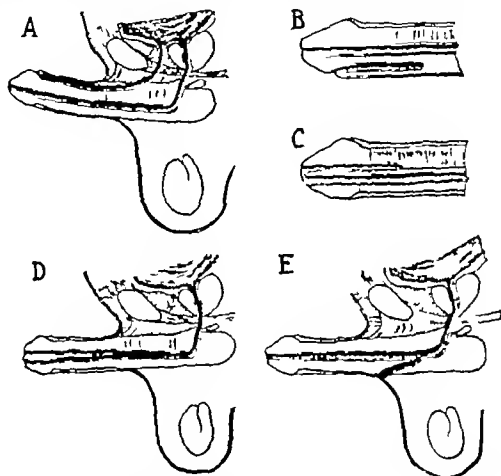


FIG. 221.—Various types of double urethrae (Taken from article of Dr E. Chauvin in *Jour d'Urologie* 23: 289 [April] 1927.)

- A. Complete reduplication of the urethra.
- B. Blind ending second canal below normal urethra.
- C. Same above urethra.
- D. Bifurcation at distal end.
- E. The second urethra opens at penoscrotal junction.

THE DIAGNOSIS can be made by radiography following introduction of opaque ureteral catheters into the true and accessory urethrae respectively or by urethrog raphy (Chap 7).

TREATMENT Usually no operative interference is required. If so, a blind ending accessory canal can be excised or its lumen obliterated by application of an electrode and the high frequency current. The ideal method is to excise the canal throughout its length.

Congenital Urethral Stricture. A stenosis of the external meatus of congenital origin has been referred to previously. Occasionally a stricture also of

Balanic epispadias, although the simplest form, is the most uncommon. The glans and the body of the penis appear flattened or spread out, but otherwise normal. In some cases, the glans is completely divided and there may be a blind opening on the upper surface of the glans.

In penile epispadias, the urethral opening on the dorsum of the penis is usually just in front of the symphysis. The penis is very short and there is often an absence or rudimentary development of the prostate. The penis is curved upward with a wide groove on the upper surface which can often be seen only when the penis is bent downward.

Complete epispadias without exstrophy of the bladder, is rare. We have seen one case. These patients are incontinent, are constantly wetting themselves, and the constant dribbling makes life miserable for them. In exstrophy, the lower abdominal wall is lacking and there is a separation of the pubic bones.

Hypospadias This anomaly is the opposite of epispadias, the urethral opening being on the inferior surface of the penis (Fig. 237), whereas in epispadias it is on the dorsum of the penis. In this deformity the urethra terminates in an opening in its lower wall, instead of the meatus in the glans penis. It is a very common anomaly. The balanic type is often of a mild degree, and in many cases can be considered within the range of normal. Three types or degrees of hypospadias are recognized, the balanic, the penile and perineal hypospadias (Fig. 224).

In its most common form, hypospadias consists of an open groove, where the meatal portion of the urethra is normally present, together with an absence of the frenulum. The glans is shorter and imperforate and at the point of the normal meatus there is usually a blind depression (C of Fig. 224) which may be above and separate from the lower groove or may be at the top of the groove. This blind meatus is usually infected during the course of gonorrhea and often proves hard to treat.

The hypospadiac orifice is usually contracted, it being difficult as a rule, to pass the larger size instruments. The patient with a hypospadias is more difficult to treat when he develops gonorrhea, and the infection persists longer because of the narrow meatus and poor drainage. The vast majority of cases of balanic hypospadias present no symptoms and the only discomfort occurs with urination when the penis must be bent upward to direct the stream properly. Some of the individuals with the more marked types of balanic hypospadias may be relatively sterile because the semen may not be ejaculated into the vagina at all or only at the vestibule.

IN PENILE HYPOSPADIAS, the orifice of the urethra is usually at the penoscrotal angle (D of Fig. 224) or it may be in the deeper portion of the anterior urethra. This type is more common than the perineal hypospadias which is the least frequent of all. Both the penile and perineal hypospadias are, however, uncommon. In the penile hypospadias there is a downward curvature of the penis and usually adhesions of the penis to the scrotum. There may be a complete cleft of the scrotum. The portion of the urethra between the hypospadiac orifice and the normal meatus is absent in hypospadias (Figs. 223 and 224).

IN PERINEAL HYPOSPADIAS, the scrotum is bifid, the penis rudimentary and the urethral orifice 3 or 4 cm. in front of the rectum. The folds of the scrotum

appear like labia. The patient must sit down in order to urinate. This perineal type of hypospadias presents the familiar appearance of pseudohermaphroditism.

Hypospadias does not occur behind the triangular ligament and hence the compressor urethrae muscle is never involved so that even in perineal hypospadias the patient does not have urinary incontinence.

INJURIES OF THE PENIS AND URETHRA

In the majority of all severe injuries of the penis the urethra is involved to some extent. In some cases there may be extensive injury to the penis without a rupture of the urethra.

INJURIES OF THE PENIS

Injury of the penis is an infrequent occurrence. The penis may be wounded by design by the insane in the form of self mutilation or injury may be inflicted by another individual. Most of these injuries are superficial.

Complete division of the penis has been reported.

One of us saw a complete avulsion of the glans penis as the result of suction with a vacuum cleaner. Bleeding was profuse and after the glans had been removed a functioning organ still remained with the corpora cavernosa intact the urethral meatus being at the fossa navicularis.

Denudation of the skin of the penis partial or complete has been reported. This is sometimes seen in severe injuries to the perineum in which the penis is also injured.

Contusions of the Penis. Subcutaneous hemorrhage following superficial injury may be quite extensive. The discoloration sometimes seen after circumcision in which there has been some subcutaneous hemorrhage may be extensive. There may be a secondary infection either superficial or deep in the corpora cavernosa as an end result. Application of cold and pressure over the penis by the hand or a bandage will limit the subcutaneous bleeding and usually control it. Occasionally gangrene and a slough may develop where the hemorrhage has been very severe.

Inclosed Wounds. If superficial they heal rapidly without doing much damage. In internal urethrotomy the corpus spongiosum and sometimes the corpora cavernosa, are cut, followed by a scar resulting in varying degrees of incurvation of the penis. This usually clears up after a number of months but in some cases it is permanent.

Punctured wounds of the corpora cavernosa produced by infiltrating anesthesia deep into the corpora cavernosa may in some cases be followed by considerable hemorrhage and later secondary infection.

Fracture of the Penis. This has been reported. The penis in the erect state may be fractured by a sudden attempt at depressing it. The attempt to break a chordee (rarely practiced now) by a blow or letting a window fall down on the organ has caused the rupture of the corpora cavernosa and urethra with extensive hemorrhage.

Dislocation of the Penis. As the result of violent injury the entire penis may separate from the integument and become displaced into the scrotum, groin, perineum or under the abdomen.

Gunshot Wounds Extensive injuries to the scrotum and perineum have been seen as the result of laceration from high explosive and shrapnel. The penis may be completely severed or the maceration of tissue so extensive as to require amputation. One of us removed a round fragment of shrapnel that had become lodged in the corpora cavernosa. In another case a bullet was removed that had become lodged in one corpus cavernosum. The urethra was not involved in either case, and there was no difficulty in urination. In the patient who had a shrapnel removed from the corpora cavernosa the fibrosis and scarring had made erection impossible.

Constriction of the Penis The introduction of the penis into a ring (Fig 225) with resultant constriction has often been reported. Edema develops rapidly and the constricting band can only be removed with difficulty. Gangrene of the penis and urethra with

FIG 225



FIG 224

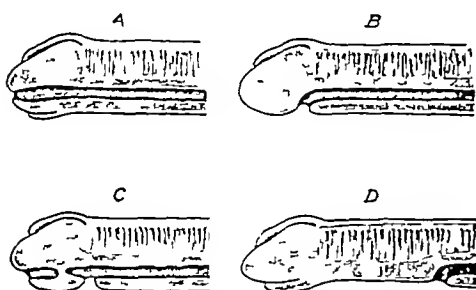


FIG 224—Most common types of hypospadias (After Papin)

A Normal urethra and meatus

B Orifice of hypospadias is at base of glans penis

C Same as B but there is also a blind depression corresponding to normal location of external meatus

D The hypospadiac opening is at penoscrotal junction

FIG 225—Incipient gangrene of penis distal to area where a constricting band had been placed by patient

a permanent urinary fistula, may be an end result. Tight bandaging of the penis in attempting to prevent hemorrhage or a tight bandage following circumcision, may produce considerable edema from constriction. The placing of a tight rubber band, string or bandage over a dressing covering the penis, so that this dressing may remain undisturbed, should be guarded against, for considerable edema of the penis may result.

INJURIES OF THE URETHRA

Wounds of the Urethra. Tearing of the urethral mucosa as the result of rough instrumentation, produces considerable hemorrhage and may result later in a scar, with a sequel of traumatic stricture. Free bleeding at the meatus is controlled best by compressing the penis tightly for a few minutes by means of a bandage over its entire length, or by compression of the penis with the palm of one hand.

False Passages The urethra may be perforated (Fig 194) during efforts

to pass a stricture by force a hematoma will form and within a few hours acute urinary retention and a beginning urinary extravasation in the perineum follow. We have seen a few cases that terminated fatally.

Foreign bodies and calculi that become impacted may traumatize the urethra to a considerable extent.

Bullet wounds may involve the urethra. One of our patients was shot in the buttocks the bullet emerging into the prostatic urethra.

Rupture of the Urethra. This is the most common urethral injury. It may be due to various forms of external force and can involve any part of the canal. The force is usually applied over the perineum and in the vast majority of cases involves the bulbous urethra. The membranous portion of the urethra traverses the very tough triangular ligament (Fig. 48) which is torn only with difficulty; hence the posterior urethra is seldom involved in traumatic rupture. The pendulous urethra is frequently injured but complete tears are rare.



FIG. 226.—Diagrams to show (left illustration) how urethra can be torn in fracture of pelvis by extension of laceration of tissues alone. In the right illustration, is shown how a fragment of bone can tear urethra (Papin.)

Direct Violence. The most common forms of direct force or violence which cause rupture of the urethra are (a) a fall astride a beam (b) being impaled on a fence or hard object or (c) a kick over the perineum.

THE PENDULOUS OR PENILE URETHRA can as a rule only be injured when the penis is erect. The attempt to break a chordee and the so-called "fracture" of the penis sometimes occurring as the result of violent attempts at coitus are the usual causes of extensive injury to the corpora cavernosa and may be associated in these cases of injury of the pendulous or penile urethra.

THE POSTERIOR URETHRA is, as a rule only injured in association with extensive injuries or fractures (Figs. 226 and 227) of the pelvis and occasionally from direct injury to the perineum. In these cases, the membranous urethra alone is as a rule torn and accompanying it there may be some injury of the triangular ligament. The prostatic urethra is seldom torn, except in very extensive injuries.

THE INJURY TO THE BULBOUS URETHRA may be of varying degrees of severity. In the milder forms the urethra is not completely torn through and a subcutaneous hematoma develops. In the moderately severe forms the urethral tear results in the formation of a large periurethral hematoma and incipient urinary infiltration. In the most severe forms of urethral injury there is extensive injury to the corpus spongiosum and the subcutaneous bleeding involves the scrotum, penis and groins. The force being exerted by a blunt object, as a rule, does not cause any laceration of the skin. The roof of the urethra usually escapes injury. The mechanism of rupture of the bulbous urethra varies with the direction of

the blow If the injury is from the side, the pubic bones may separate at the symphysis and cut the urethra almost completely across When the force acts from below, as is most common, the urethra is torn by the sharp edge of the pubes The most common cause of rupture of the urethra is fracture (Figs 226 and 227) of the pelvis as the result of an automobile accident In every large fracture ward one or two patients with fracture of the pelvis and rupture of the urethra can usually always be found It is also common to see the aftermath of this injury in the urologic wards, consisting of a persistent perineal urinary fistula, and impassable or tight stricture



FIG 227—Cystogram four years after rupture of urethra due to fracture of pelvis Note displacement of right pubic bone at symphysis and to right of same The cystogram shows the bladder to be irregular in outline and dilated due to lack of bony support

Symptoms The principal symptoms of rupture of the urethra are tumefaction, inability to urinate or difficulty in urination, urinary retention, pain and bleeding Secondary infection may develop later, but the most serious complication is urinary extravasation

IN INJURIES TO THE PENDULOUS URETHRA, the symptoms are usually mild There is slight hemorrhage and the patient has some pain The difficulty in urination is readily relieved with the retention catheter Infection and urinary extravasation may occur, but they can usually be controlled

IN RUPTURE OF THE PENDULOUS URETHRA, the symptoms, although occasionally mild, are usually quite severe There is intense pain immediately after the injury, becoming more and more severe as the result of the tumefaction resulting from the hemorrhage Each urination is painful and increases with successive urinations The beginning urinary infiltration, and later, the secondary infection aggravate the symptoms

HEMORRHAGE AT THE MEATUS is usually quite marked at first consisting only of liquid blood, later of clots. It may be so extensive as to cause acute retention. The hematoma in the perineum develops, if the injury is severe and is accompanied by urinary extravasation.

THE DIFFICULTY IN URINATION appears at once. The patient experiences a great deal of pain and is only able to pass a few drops of urine and fresh blood. Acute retention results from the edema of the posterior urethra. Within a few hours the patient is unable to urinate and there is a rapidly spreading tumefaction and discoloration (Fig 228) from the hematoma.

URINARY EXTRAVASATION does not develop early following injury to the normal urethra in contrast with the extravasation that rapidly follows the false passage of a sound and tear of the urethra in an old gonorrheal stricture. In complete tear of the normal urethra the bladder sphincter remains intact, spasm follows, and there is usually very little escape of urine until the bladder becomes over distended and thus urinary extravasation as a rule does not follow immediately but begins about 24 hours after the injury. The early extravasation and discoloration following an injury is practically always due to hemorrhage.

If the injury is in the membranous or prostatic urethra there may be an absence of bleeding from the external meatus. The urinary extravasation will be deep-seated in contrast to that which takes place in a urethral injury in front of the triangular ligament. Urinary extravasation in injuries of the urethra behind the triangular ligament extends into the perivesical tissues and between the prostate and rectum.

Diagnosis. The degree of injury can only be judged by the symptoms. In many cases, it is difficult to determine the extent and severity. The history of direct trauma to the perineum taken in conjunction with the symptoms are the chief factors in enabling a diagnosis to be made. The use of a catheter is contraindicated except immediately before operation or when it has been determined that the slow development of the perineal tumefaction indicates a slight injury. Catheterization is a dangerous procedure because of the additional trauma and risk of infection. When the injury is extensive catheterization is of no avail. Rupture of the bladder may be present as an associated injury and should be differentiated. Rupture of the bladder can be diagnosed by intravenous urography. The resulting cystogram will show evidence of extravasation of the opaque medium in the perivesical tissues.

Prognosis. The mortality from urethral injuries is slight except in cases



FIG. 228.—Hematoma of penis, scrotum, perineal and anal regions following traumatic rupture of the bulbous portion of the urethra.

of extensive injury and in those which have not been treated until diffuse urinary extravasation has taken place. A traumatic stricture is nearly always the sequel of a rupture of the pendulous or bulbous urethra. The chronic extravasation (Fig. 229) and multiple fistula formation resembles similar sequels of nontraumatic stricture (see Chapter 8).

Treatment In cases in which the symptoms are mild and there is no evidence of urinary extravasation, rest in bed, plenty of fluids and internal antiseptics suffice.



FIG. 229—Two views from case of chronic extravasation of urine. Note enormous edema of penis and scrotum in the anterior view and the multiple fistulous openings as seen in view from behind.

With early hematuria, beginning urinary extravasation and severe symptoms, immediate external urethrotomy is indicated. In extensive destruction of the urethra, an attempt should be made, if possible, to unite the divided ends of the urethra at the same sitting, i.e. at the same time of the urethrotomy. The cut ends of the anterior urethra will retract so that union of the ends may be difficult, later. In many cases, the injury to the bones of the pelvis and the soft parts is extensive, and external urethrotomy is either very difficult or practically impossible. The patient is often in shock on these cases, and it is, therefore, far better to do a suprapubic cystotomy for diversion of the stream, and repair the urethra later. In some cases a combined cystotomy and external urethrotomy can be done at the same sitting, the retrograde passing of the sound or catheter making possible the repair of the divided urethra.

FISTULAE, FOREIGN BODIES AND CALCULI OF THE URETHRA

Urethral Fistulae Urethrorectal fistula may follow spontaneous evacuation of a prostatic abscess into the rectum.

The rectum may be accidentally entered in exposing the prostate when doing

a perineal prostatectomy. When this occurs, the rectal injury should be repaired, the perineum closed and a suprapubic cystotomy done. If the operation is continued and the prostate removed perineally at the same sitting a urethro-rectal or vesico-rectal fistula always results even though the rectal tear has been repaired.

Fistula of the pendulous or scrotal urethra is usually secondary to a gonorrheal periurethral abscess and eventually clears up with dilatation of the urethral infiltration. External urethrotomy of the anterior urethra in either its scrotal or pendulous urethra will very often result in a permanent fistula.

Urethral fistula secondary to a periurethral abscess at the frenulum—paraphrenitis—usually presents itself by the escape of a few drops of urine during urination. Injection of a dye through the external opening will cause it to appear at the meatus and is diagnostic. These fistulae are often difficult of repair however careful dissection and removal of the tract is usually successful. Fulguration or cauterization with chemicals may obliterate the fistula.

Congenital Urethrorectal Fistula. This usually occurs in association with imperforate anus, less often with congenital stricture of the rectum. Twenty-one of the twenty-four cases observed by Campbell had been operated upon a few hours after birth for imperforate anus. The symptoms are the passage of urine per rectum or feces with the urine. The diagnosis is made by urethroscopy and confirmed by urethrography. The best treatment is excision of the fistulous tract.

In a case reported by Young (Jour. A. M. A. 1936 107 1448) in addition to a recto-urethral fistula in a boy 17 years of age there was also a hypospadias (Fig. 224). By means of a series of plastic operations it was possible to close the openings in the rectum and urethra, respectively and bring the rectum out through the sphincter in a newly made anal orifice thus establishing normal urination and defecation.

Foreign Bodies. These are either objects introduced through the meatus for the purposes of sexual excitation or have remained in the urethra following instrumentation. Peacocks hairpins, wires and other objects which have been inserted for the purpose of masturbation have been removed from the urethra and bladder.

A filliform attached to a follow up sound (Fig. 79) may break off and remain in the urethra. A filliform left in place along which the patient can urinate can slip back into the urethra if not well tied to the glans. In the use of rubber covers for dilators the rubber has become torn and a portion of the rubber remained in the urethra. Cotton applicators may become detached from the applicator in urethroscopic treatment but are as a rule readily washed out with urination. A spicule of bone may enter the urethra from the outside following fracture of the pelvis.

Calculi. These are usually ureteral calculi (Fig. 230) which have become lodged in the urethra on their way out. The most common point of obstruction is the meatus, so that the calculi can either be seen or readily removed by manipulation or meatotomy. If the calculus becomes lodged in the posterior urethra and causes obstruction, it is best to push it back into the bladder with a sound. The patient will usually force it through the urethra on the next attempt at passing the stone.

DISEASES

DISEASES OF THE PENIS

The outer layers of the skin only, may be involved in certain cutaneous affections such as scabies and herpes. Inflammatory processes such as lymphangitis, abscess and gangrene may also affect this organ. Benign papillomata (venereal warts) are common and malignant growths are occasionally seen.

CUTANEOUS SCABIES

Scabies The lesions have a predilection for the penis. The minute multiple elevations with burrows in the center, found very commonly on the glans, are characteristic. They itch considerably and are associated with similar lesions

FIG 230



between the fingers and on the wrists. Lesions of the penis due to scabies are common and can readily be differentiated from herpes or secondary syphilis. Pyoderma following scabies may leave permanent scars on the penis.

Herpes Herpetic lesions of the penis (Fig 213) are frequently seen

FIG 231



FIG 230—Necropsy specimen showing a number of calculi in the posterior urethra
FIG 231—Balanitis (White and Martin)

and often require differentiation from chancroid and balanoposthitis. They are usually found on the glans, but often also on the skin of the prepuce. The vesicles are superficial, there is no history of exposure and no particular incubation period. There is some pain and itching and within a few days the lesions disappear without leaving a mark. The vesicles are in groups and there is no punched out ulceration. Recurrences are common and since they occur on a sensitive irritable glans, will usually be prevented by circumcision.

Eczema is usually associated with a chronic balanoposthitis. It is usually present with chronic adhesions of the prepuce. It may also occur at the base of the penis.

Secondary syphilides are common on the penis and are usually associated with lesions on the scrotum and condylomata lata about the anus.

Hair Follicle Infections. Folliculitis is by no means uncommon and the patient is usually very much disturbed over this. An abscess, usually minute develops within a few days.

It can be incised. Occasionally adenopathy develops secondarily. These infections develop as a rule on the shaft of the penis on either side or very commonly at the base. Very often there is a multiple infection together with some folliculitis around the pubis. Erysipelas may attack the penis. Tuberculosis of the penis is rare.

Papillomata. Venereal warts, verruca or condylomata accuminata. Although these should be classified under tumors because they are benign papillomata they are so common that it is best to mention them here. Although commonly termed venereal warts they are not venereal in origin and most commonly occur without a gonorrhea. They are nearly always multiple appearing very commonly behind the corona and sometimes in the form of a rosette here. They also develop on the inner surface of the prepuce and on the glans. Another favorite location is at the margin of the meatus and when found here there are often some papillomata within the urethra.

They are sometimes very large and may present a typical cauliflower appearance. Some are flat others small, soft and pedunculated. Some are vascular particularly those on the glans penis and bleed readily when cut. They are due to irritation and inflammation the most common etiologic factor being a tight or long prepuce the surface of which is actively secreting or has a mild degree of balanoposthitis. Uncleanliness and the accumulation of smegma are also etiologic factors. At the meatus they not infrequently develop at the edge of a meatotomy incision.

When very large they may become infected and even ulcerate or suppurate. Rarely they may become malignant. They apparently multiply by implantation in many cases and may occasionally be implanted on a circumcision wound.

TREATMENT OF PAPILLOMATA. Those that are pedunculated can be removed by excision. Others can be cauterized. The application of glacial acetic acid is almost a specific the warts rapidly diminishing after a few treatments. However following their apparent disappearance recurrences are the rule. Circumcision will clear up the vast majority and is definitely indicated because it eliminates the source of irritation. The large papillomata must be removed surgically and sometimes cauterized.

INFLAMMATION

Balanoposthitis. This is an inflammation of the mucosa covering the glans penis and that on the inner surface of the prepuce and is termed balanoposthitis. Balanitis (Fig. 231)—inflammation of the surface of the glans alone may occur but if prolonged the mucosa of the prepuce also becomes involved.

A redundant and tight prepuce is the predisposing cause in nearly all cases. A certain habitus or diathesis seems to predispose. Stout, rheumatic or gouty

individuals are most commonly affected. The glans is continually moist and irritable in many men and these are always predisposed.

With a long prepuce and the constant irritation from excessive secretion of the mucosa and glans, it is very common in routine examination to find many men who have considerable hyperemia and redness of the mucosa of the glans and with it usually some slight redness at the meatus with a slight watery discharge. In those who permit smegma to accumulate, this is a predisposing factor.

Some degree of balanitis is associated with all inflammatory conditions of the glans and is not uncommon as the result of the irritation from gonorrheal urethral discharge. The average case presents a rather typical picture. The mucosa

FIG 232

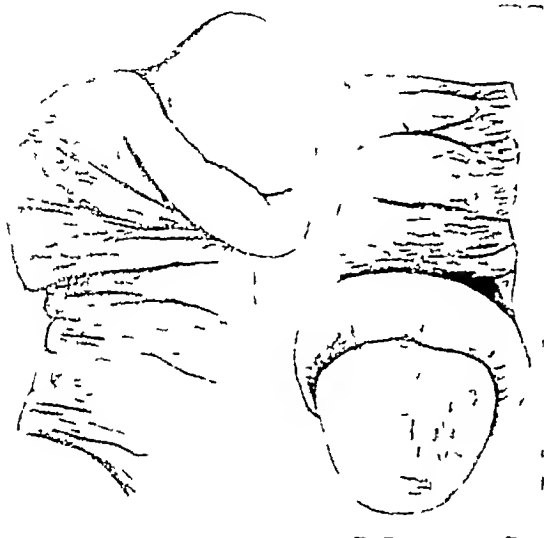


FIG 233

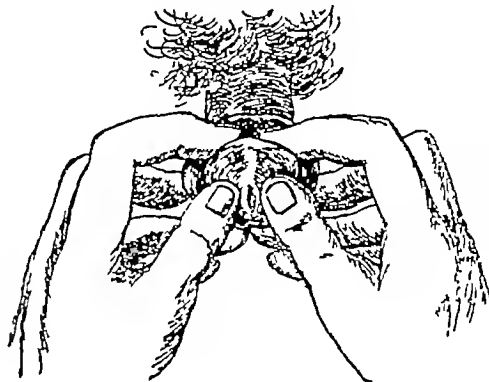


FIG 232—Lateral and dorsal views of a paraphimosis (Kaufmann)

FIG 233—How to reduce a paraphimosis. The glans is grasped on each side by the thumbs and index fingers. Pressure is steadily made by the thumbs in a backward direction so as to reduce the edema of the glans until it slips into the edematous prepuce which is gradually pulled over the glans. If unsuccessful after repeated efforts, a dorsal slit must be done immediately (White and Martin)

of the glans at first becomes reddened and there is a feeling of burning or itching of the glans. The epithelium then is desquamated, the entire glans becoming moist and with it, some purulent secretion accumulates at the corona. The irregular patches of denudation with no ulceration distributed over the entire glans and prepuce, are diagnostic. They are entirely superficial and although there may be considerable infection and foul smegma associated, an adenitis is a rare sequel. The chronic balanitis associated with long standing adhesions may produce a marked thickening of the mucosa of the glans with a granular thickening of the inner surface of the prepuce.

Differentiation from an inflamed herpes is sometimes difficult, but careful observation will enable one to differentiate a balanitis from chancroids easily. Treatment consists of keeping the parts clean by retracting the prepuce and washing off all the accumulated secretions. We have been informed that retraction of the prepuce daily is an injunction among Chinese soldiers in order to prevent a balanoposthitis. Frequent bathing in warm water and keeping the parts clean, will clear up most of the cases of balanitis within a few days. Application of

twenty to thirty per cent calomel ointment or a white precipitate ointment helps clean up the lesions. Balanitis often recurs and to prevent this circumcision is necessary.

Phimosis and Paraphimosis. Phimosis is a condition in which as result of congenital narrowing of the preputial orifice or as result of chronic or acute inflammation of the prepuce, the latter cannot be retracted over the glans. Paraphimosis (Fig 232) is a condition in which as the result of edema, the previously retracted prepuce cannot be pulled forward over the glans.

Congenital phimosis has been described. As a rule the orifice of the prepuce becomes larger before puberty in these cases and the prepuce can then be retracted. Frequent attempts to retract the prepuce over a few years will enlarge the orifice sufficiently. When the prepuce is long and redundant or in cases of congenital phimosis of long standing, circumcision is definitely indicated.

Inflammatory phimosis is commonly associated with chancroids or gonorrhea. (Fig 215.) Very often the "rosette" of chancroids at the preputial orifice produces cicatrization and a phimosis results. Although gonorrhea often is complicated by considerable edema of the prepuce, phimosis is uncommon. Chronic balanoposthitis may produce considerable narrowing of the preputial orifice.

The acute inflammatory phimosis usually subsides with frequent hot applications. That associated with chancroid often requires a dorsal slit. The attempt to retract the prepuce in phimosis, often results in paraphimosis. A dorsal slit of the paraphimosis is usually immediately indicated. The tight prepuce of a chronic phimosis or one that can be retracted but gives rise to recurrent attacks of balanitis, herpes and venereal warts, is also a definite indication for circumcision.

In the inflammatory type of paraphimosis the clinical picture is typical. With the prepuce retracted, the edema is most marked (Fig 232) on the ventral surface at the frenulum. The glans is red, somewhat swollen and congested. The coronary sulcus appears deeper as the result of the swelling. The mucous membrane of the prepuce next to the sulcus, is edematous and prominent and behind this swollen fold of mucosa is found a deep furrow on the dorsum that is often ulcerated. The latter is the preputial margin and the point of constriction, and beyond this, there is a roll of edematous skin and subcutaneous tissue.

While in most cases, the paraphimosis does not produce enough constriction to obstruct the urethra or interfere with the circulation, gangrene may sometimes occur as the result of the constriction. Many gradually subside with hot applications and cleaning up of the lesions. Others can be transformed into a phimosis by pushing the glans back and pulling the prepuce forward (Fig 233). With the thumb and forefinger of each hand back of the phimotic prepuce and each thumb pressing down on the glans, the latter can be reduced and the prepuce slipped forward in a large percentage of the cases. However, a long standing paraphimosis can as a rule not be reduced.

Dorsal slit is indicated when any difficulty is met with in retraction. It is very readily done and is less painful than the repeated attempts at reduction of the paraphimosis.

LYMPHANGITIS

Involvement of the dorsal lymph cord is usually noted with any severe inflammatory involvement of the glans or prepuce. With inflammatory phimosis

and paraphimosis this is often marked. The dorsal lymph cord can be distinctly felt extending up to the symphysis and there is usually some degree of associated inguinal adenitis. It is sometimes difficult to differentiate from a phlebitis of the dorsal vein. Such a phlebitis however cannot be felt continuously up to the symphysis. Occasionally a localized abscess of the dorsal lymph cord occurs but this may develop with a phlebitis also. The lymphangitis subsides with the disappearance of the etiological factor.

Cellulitis of the Penis Brawny edema of almost the entire shaft of the penis is often found associated with an ulcerative chancre. In hyperacute gonorrhea there may be an edema of the shaft of the penis also. Chancroids and balanoposthitis and sometimes periurethral infection may produce an associated cellulitis of the penis. Erysipelas of the penis is rare.

Cavernitis and Spongitis The corpora cavernosa are sometimes involved in severe gonorrheal urethritis. The bulb of the corpus spongiosum is also sometimes affected. Infection of the corpora cavernosa may follow internal urethrotomy and may sometimes result from the injection of anesthetics deep into the corpora cavernosa during circumcision. The cavernitis can often be felt as a circumscribed ring of hard infiltration in subacute gonorrheal urethritis. When severe there is constant priapism and edema of the glans. A localized abscess may develop which must be opened freely to prevent possible sepsis.

EDEMA

Chronic Edema The edema of the penis in nephritis is classic and the penis and scrotum are a common location (Fig 229) for edema from this cause. The entire organ is swollen, the prepuce markedly so. The edema of the scrotum and associated findings make the diagnosis. Chronic edema of the penis is occasionally due to a chronic bilateral inguinal adenitis in which there is a block to the lymphatic circulation. This is often quite marked and persists in spite of all treatment. The edema becomes brawny and must often be dissected out from under the skin of the penis up to the pubis. Resection of the edematous tissue may in some cases produce gangrene.

The brawny edema of lymphatic obstruction may involve only the prepuce and the penis beyond it, for one-third of its length. This persists for a long time and must often be dissected out in doing a circumcision. The edema of elephantiasis is associated with edema of the scrotum which will be described later.

GANGRENE

This is usually the result of inflammation but may be independent of local infection. We have seen gangrene of the scrotum and penis as the result of thrombosis within the pelvis. Gangrenous balanitis has been described. Gangrene may also result from constricting rings (Fig 225) or bands placed about the penis and may also follow extravasation into Buck's fascia (Fig 204).

INDURATION (Induratio penis plastica)

The corpora cavernosa only, are involved in this condition. Minor degrees of fibrosis with fibrous plaques in the corpora cavernosa are by no means uncommon. They occur in elderly people and are of no significance. The induratio penis plastica usually described has an insidious and slow onset beginning at one point

along the shaft and forming a circumscribed mass with sharply defined margins. It interferes with erection and usually causes impotence. The induration may be limited to one region or may involve the entire penis.

The etiology of this condition is not quite clear. It may be often rheumatic or gouty in origin, being associated with a Dupuytren contracture of the palmar fascia.

In some cases, the fibrosis progresses; deposits of calcium in plaques occur and even cartilage formation has been reported. The induration never becomes malignant nor does it ulcerate. The induration as a rule does not develop before the fourth or fifth decade. By some it has been considered as inflammatory in nature.

Treatment offers very little; the condition not being amenable to drugs or to direct treatment by diathermy or x ray.

BENIGN TUMORS

Benign growths such as angioma and lipoma have been described but are rare.

Cysts are not uncommon on the prepuce, are rarely found elsewhere and are not large. They can be enucleated without difficulty.

Horns consisting of horny growths on the glans penis which are hard and which may undergo malignant degeneration, have been described.

Varicosities of the penis are not rare and may sometimes be quite marked.

CARCINOMA

Incidence, Age etc. Pack and LeFevre found cancer of the penis in 1.25 per cent of all malignant tumors in males admitted to the Memorial Hospital (New York). The average age of 120 cases reported by Dean (Jour Urol 1935 33 252) was 50 years. Of 108 patients eight were under 30 years of age while forty were under 50 at the time of the first symptom.

Race, occupation, previous constitutional diseases except syphilis do not appear to have any predisposing influence. Syphilis was either admitted or proved (usually both) in 34 per cent of 70 patients in Dean's series of 120 cases.

Chronic irritation of the glans or mucosa of the prepuce (such as is found in cases of phimosis, or when adhesions attach the prepuce to the glans or when the penis is concealed) bear a direct etiological relation to the development of penile cancer. Operative treatment to free the glans was necessary in 45 or 37 per cent of 120 patients (Dean). Papillomata of long standing may be another source of epithelioma due to malignant changes. Paget's disease of the skin of the penis may also be followed by carcinomatous changes.



FIG 234.—Epithelioma of the squamous cell type involving skin of shaft of penis.

Pathology. Two types of squamous-celled carcinoma are found, the flat and the papillary. In 116 cases, reported by Dean, the flat was found in 57 per cent and the papillary in 43 per cent. The flat type infiltrates and excavates deeply, whereas the papillary grows toward the surface and forms a cauliflower-like growth. Buck's fascia (Fig 56) acts as a barrier to the extension of a cancer of the penis, penetration of the corpora cavernosa occurring earlier than that of the corpus spongiosum. We have seen one patient with a squamous-celled carcinoma of the shaft of the penis.

Extension usually takes place by way of the lymphatics (Fig 54), less often through the cavernous tissue. The lymphatics of the skin and urethra drain into the superficial and deep inguinal nodes, which in turn communicate with those over Scarpa's triangle and with the nodes along the course of the external iliac and hypogastric arteries. Those of the cavernous bodies drain directly into the lumbar nodes. The pelvic nodes may be invaded without involvement of the inguinal nodes.

Symptoms and Diagnosis. The flat type usually first appears as a small, superficial round ulcer, but extension into the depth and on the surface takes place rapidly. A few cases begin as leukoplakia patches which have become malignant. In the other, papillary type of carcinoma, the incipient lesion is a wart, which constantly recurs in spite of treatment, on the glans or inner surface of the prepuce. The warts soon increase in number and coalesce to form a cauliflower-like mass. As the result of infection, there may be a fetid discharge, occasionally blood-tinged. The patient's first symptom depends upon the degree of phimosis, because in many of these patients, the prepuce has seldom or never been retracted.

The differential diagnosis from syphilis, benign papillomatosis, leukoplakia, should always be made by biopsy, because much valuable time is lost in waiting for the results of antisyphilitic treatment or in fulguration of warts. Every precancerous lesion such as a leukoplakia, wart or keratosis should be removed and causes of irritation such as an adherent or tight prepuce relieved by circumcision. Palpation of the lymph nodes cannot always be depended upon. Enlarged nodes may be nonmalignant. Regional adenopathy was only present in 76 per cent of 112 patients (Dean) and, of these, only one half had metastases.

Practically all of the tumors are of Grade I or II (Broders). Bowing found that 60 per cent of 195 were of Grade II.

Treatment. The ideal method of prophylaxis would be to circumcise every baby, yet occasionally (Wolbarst) a cancer of the penis is found in a circumcised individual. Removal of precancerous lesions has already been referred to.

As to the choice of treatment, cases may be divided into three groups.

Group 1. Those with small superficial primary tumors. Good results in the treatment of early lesions less than 2 cm. in diameter with Radon enclosed in gold tubes are reported by Dean, Bowing, Desai and Pfahler. Others like Leighton (West Jour Surg 1934, 42, 226) state that early amputation (Chap 48) combined with regional lymph node removal have given the best results in early cases.

Group 2. Larger primary tumors. When the cancer is larger than 2 cm. in diameter or has invaded the deeper tissues, amputation 1.5 proximal to any visible or palpable evidence, should be carried out. Partial amputation suffices in most cases. It is rarely necessary to do a radical amputation. As stated under

Group 1, many with large experience (Leighton, Desai, Young, Colby and Smith) believe that the regional lymph nodes should be removed at the same sitting. Deao (loc. cit.) does not believe that this additional operation is indicated because, first, local recurrence was never observed following amputation 1.5 cm proximal to the primary growth, second 60 per cent of the patients had no metastases and third the radical operation has a mortality of 20 per cent. If necessary, groin metastases can be operated later.

Pfahler and Widmann employ electrocoagulation of the primary tumor in this second group instead of amputation, and follow it with irradiation of the inguinal regions. Dean is of the opinion that external radiation from the radium pack or 200 kilovolt Roentgen ray unit is of little value in the treatment of metastases. The 700 kilovolt unit or more powerful source of radiation with the divided dose may prove to be useful.

SARCOMA

Incidence and Types. Joelson (Surg. Gyn. and Ob. 1924 38 150) reported a personal observation and was able to find reports of 35 cases in the literature. Since publication of Joelson's article we have found eleven additional cases making a total of 47 observations of this relatively rare form of malignant tumor of the penis. Of these 47 cases, 12 were endothelioma, 10 were melanosarcoma, 5 were spindle cell sarcoma, 4 were fibrosarcoma, 4 mixed cell sarcoma and one each of fibrocellular round celled and myosarcomatous type. In the others the type was not mentioned. In the cases reported since 1924 it is of interest to note that the endotheliomas presented at the onset as firm nodules at the base of the penis (Balog, Yamamoto) having their origin in the corpus cavernosum or as a nodule on the glans (Dobrzaniecki) in the endotheliomas. In one melanosarcoma case (Colby) a nodular pigmented ulcerating mass was present on the glans. In another melanosarcoma case (Campbell and Felt) there was a mass at the penoscrotal junction. In the fibro and myosarcoma cases (Levi, Kreibitz) the primary lesion was a nodule on the skin or glans. This was also true of the spindle-cell cases (Meller, Albio Schmidt) and in the round cell type (Mark). The tendency to nodule formation with late ulceration except in the melanosarcoma type seems to be the only diagnostic characteristic from cancer of the penis, hence early biopsy appears to be indicated to exclude a cavernitis from an endothelioma and nodules on the skin or glans from sarcoma.

The treatment is the same as for carcinoma. In spite of amputation death from early pulmonary metastases occurred early in some of the reported cases.

DISEASES OF THE URETHRA

Infections of the Paraurethral Glands at the Meatus. The opening of the ducts on each side on the lips of the meatus are occasionally seen (Fig. 53). These glands are merely prolongations of Littre's glands and often become infected in gonorrhea. The infection persists, is stubborn and often recurs. Cauterization with silver nitrate and fulguration is indicated and usually clears up the infection.

Caruncle of the Urethra in the Female. This will be discussed in Chapter 45 "Urology in the Female."

Papillomata of the Urethra. These are similar to the venereal warts seen externally and are usually the result of irritation from chronic inflammation.

mined If there is any question as to the induration being benign or malignant, a biopsy should be done, preferably by incision over the induration

Lazarus (Jour Urol 1934, 31, 823) in reporting a case, emphasizes the necessity of suspecting the presence of a carcinoma in any urethral stricture of long standing, which fails to yield to the usual methods of dilatation and is accompanied by a hemorrhagic urethral discharge One should also look with suspicion upon a peri-urethral abscess complicating a stricture in the membranous urethra which does not improve with treatment

Treatment If the tumor is located in the penile portion an amputation well beyond the induration, followed by removal of the inguinal lymph nodes, is advisable For those in the posterior urethra, resection may be feasible in some cases, preceded by suprapubic prostatectomy If urethrectomy is impossible, irradiation is the only method to be employed

SARCOMA OF THE MALE URETHRA

This is rare as compared to carcinoma of the urethra Bailey (Jour Urol 1934, 32, 103) added a personal observation to eight cases previously published

Sarcoma of the urethra must be differentiated from sarcoma of the corpus cavernosum In the latter, the enlargement of the penis takes place earlier and is usually symmetrical Urinary obstruction and pain is complained of later than in sarcoma of the urethra

HERMAPHRODISM²

True Hermaphrodisism In the classical sense, a hermaphrodite is an individual who has the gonads (see Chapter 1) and external genitalia of both sexes This condition is termed True Hermaphrodisism It is very rare, so that Young² was only able to find twenty cases which could be accepted as true hermaphrodisism, i.e. verified microscopically The bisexual conditions were discovered during herniotomy in seven cases, during laparotomy in six and at necropsy in seven All but four patients had passed the age of puberty and twelve were twenty years of age or over before the condition was discovered The twenty cases of true hermaphrodisism in the literature may be grouped as follows

GROUP A Ovary on one side, ovotestis on the other, five cases

GROUP B Testis on one side, ovotestis on the other, four cases

GROUP C Ovotestis on one side, character of gonad on other side undetermined, three cases

GROUP D Ovotestis on each side, six cases

GROUP E Testis in scrotum on one side, ovary in pelvis on the other side, three cases

False Hermaphrodisism A pseudohermaphrodite is a person in whom the gonads of only one sex are present, but the abnormalities of the external genitalia are such that doubt exists as to the true sex In many of these cases the secondary

² We are indebted to Dr Hugh H Young for permission to utilize the material on this subject which appears in his recent (1937) classical treatise on Genital Anomalies, etc published by Williams and Wilkins Co

sex characteristics are so altered that the character of the individual is that of the opposite sex. In such persons the sex has often been wrongly interpreted at birth and they have been brought up as boys when really girls and vice versa. In many cases, abdominal section must be carried out before it is possible to determine the true sex. Young has adopted the following nomenclature which appears to be the simplest. If the gonads are testes the patient is called a male pseudohermaphrodite if the gonads are ovaries, a female pseudohermaphrodite. Cases in which, for one reason or another no positive diagnosis can be made as to the exact sex of the individual are termed Hermaphrodites 'sex undetermined'.



FIG. 235.—Male pseudohermaphroditism. Photograph of a male pseudohermaphrodite. Note penis with marked chordae and the opening of a vagina with well developed labia minora.

Male Pseudohermaphrodites. One needs only to cite the following progressive abnormalities of the genitalia as observed by Young to appreciate the diversity of combinations found clinically.

The male pseudohermaphrodite cases as observed and operated by Young (see Chapter 4 of his book) were

- 1 With hypospadias
- 2 With hypospadias and vagina
- 3 With hypospadias, vagina and fallopian tube
- 4 With vagina, uterus tubes and pelvic testes
- 5 With uterus, tubes, two pelvic testes and a vagina opening into the urethra

and 6 With the last named abnormality and three testes, one in scrotum, one in inguinal canal and a third in the pelvis

Female Pseudohermaphrodites Young observed four cases, all of which presented the following conditions

- 1 Greatly enlarged adrenals with hypertrophy of the androgenic or prenatal zone of the cortex

- 2 Hypoplastic or infantile ovaries with multiple cysts, probably resulting from the repressive influence of the adrenal hyperplasia

- 3 An enlarged clitoris, a persistent urogenital sinus into which the vagina opened and surrounding the vaginal orifice, a hymen

CHAPTER 18

THE PROSTATE

ANOMALIES	PATHOLOGY OF OBSTRUCTIVE LESIONS
INJURIES OF THE PROSTATE	EFFECTS OF OBSTRUCTION
PROSTATIC CALCULI	CLINICAL PICTURES
INFECTIONS OF THE PROSTATE	DIAGNOSIS
ACUTE PROSTATITIS	TREATMENT
CHRONIC PROSTATITIS	MALFORMANCES OF THE PROSTATE
TUBERCULOSIS OF THE PROSTATE	CARCINOMA OF THE PROSTATE
SYPHILIS OF THE PROSTATE	SARCOMA AND OTHER RETROPERINEAL NEOPLASMS
HYPERTROPHY OF THE PROSTATE AND OTHER BLADDER NECK OBSTRUCTIONS	

ANOMALIES

Complete or Partial Agenesis. Complete absence is rare and usually accompanies some other serious faulty development of the urogenital tract such as bladder exstrophy (see Chap 14), hypospadias (Fig 224) agenesis of both testes bilateral cryptorchidism (see Chap 21) Partial absence i.e., of one lobe is even rarer than of both lobes. Unilateral lack of development or hypoplasia of one lobe is a little more frequent, and is found in cases of congenital solitary kidney¹ on the agenesis side accompanied by a similar lack of development of the testis or epididymis or of both. None of these three anomalies of the prostate are of much clinical interest because they do not give rise to any symptoms

Congenital Cysts These are of more clinical interest and are of two varieties (a) those which are found in the prostate itself and (b) those which develop between the prostate and rectum i.e. retroprostatic. According to English² the first named may cause retention of urine at birth. They either rupture spontaneously as the result of the effort to urinate or are opened during the passage of a catheter. The retroprostatic type of cysts is the result of faulty development of the müllerian or wolffian ducts and may cause partial or complete urinary retention. Most of these cysts are cysts of the utricle. In such cases, operative interference by the perineal route may be necessary. Trans-urethral approach either by sound or resectoscope is most satisfactory for removing cysts of the utricle.

INJURIES OF THE PROSTATE

Owing to its location far within the perineum injuries of the prostate are rare. They rarely occur after blows or falls upon the perineum. Gunshot and penetrating injuries by swords, bayonets pitchfork etc. are also rare. We removed a bullet that had lodged in the prostate. Laceration of the prostate by a bone fragment in fractures of the pelvis (Fig 226) is occasionally encountered. Perhaps the most common mode of injury is due to attempts to pass metal catheters or sounds, or during the use of lithotrites. Forceful attempts to empty the bladder in cases of obstruction at the bladder neck (Fig 251) may result in a false passage (Fig 244) which tunnels the prostate. This most commonly occurs when a metal

See Chapter 32

Quoted by von Frisch Die Krankheiten der Prostata, 1910.

catheter or sound is used. Marked bleeding may ensue and the patient is worse off than before. The rigid metal instrument cannot accommodate itself to the tortuous prostatic urethra.

Symptoms of Injury of the Prostate

1 Hemorrhage This may appear as an escape of blood from the external urethral meatus, independently of micturition or accompany the latter act. In penetrating injuries, there may be constant bleeding from the wound of entrance in the perineum or anterior wall of the rectum. There may be but little visible bleeding in cases in which the periprostatic venous plexus (Fig 43) is extensively torn, the blood escaping into the pre- and perivesical spaces (Fig 51), i.e., sub-peritoneally. Bleeding from an injury of the prostate may be so severe as to threaten life. We have seen arterial bleeding from the prostate following trans-urethral resection which had almost exsanguinated the patient in 3 hours.

2 Periurethral and Perivesical Urinary Extravasation If there is an accompanying rupture of the urethra or of the vesical neck, the urine escapes into the tissues around the prostate, giving rise to the same symptoms and sequelae, as have been described under injuries of the urethra. This is not a rare complication of trans-urethral resection, and is often fatal. Air may also escape into the tissues. If recognized within a few hours prompt exposure and drainage is indicated.

Treatment of Prostatic Injuries Every effort must be made to control the hemorrhage if this is severe. The perineal mode of approach is preferable to any other. If the bleeding is not very severe, the first indication is to employ an indwelling catheter which will usually control it (Fig 106). When catheterization is difficult or impossible cystotomy may be necessary to relieve the urinary retention that may follow. In cases of penetrating injury either by way of the perineum or anterior wall of the rectum, complete exposure of the entire tract taken by the missile should be made as soon as possible to forestall the development of infection.

PROSTATIC CALCULI

They may be single or multiple and vary considerably in size (Fig 236). These consist in the individual case of a number of yellowish-brown calculi varying in size from a millet seed to that of a pea. Most of the stones are very small, some are almost black in color, and are usually found lying between the prostate and its capsule. They frequently accompany prostatic hypertrophy, and are usually discovered only when prostatectomy is done. When very small and not numerous they present no radiographic evidence, and are of no clinical significance. Calcified corpora amylacea are a frequent post-mortem finding, and are also of no clinical significance. When the calculi are numerous infection of the prostate with some localized abscess formation is also present. A far less common form of prostatic calculus is the large stone that has developed in the cavity of a prostatic abscess.

Secondary Calculi These form primarily in the kidney, bladder or urethra and then wander into the prostatic urethra where they often attain larger dimen-

sions than they had originally. Occasionally a stone develops in the cavity of the prostatectomy wound. It usually forms itself into the typical dumb-bell stone, with the largest portion lying in the bed of the prostatic cavity, its neck occupying the bladder neck and the smaller portion of the dumb-bell in the prostatic urethra. This is not a rare occurrence and requires open surgery. Some bladder calculi found in old men with enlarged prostates are primarily prostatic calculi. They are yellowish-brown in color, faceted, cuboidal in shape, about the size of a large pea and may be 10 to 20 in number, lying at the base of the bladder, often overlapped by the prostate.

Symptoms etc., of Prostatic Calculi

There are no pathognomonic symptoms due to the presence of the calculi because they are either overshadowed by those of chronic infection (see later) or

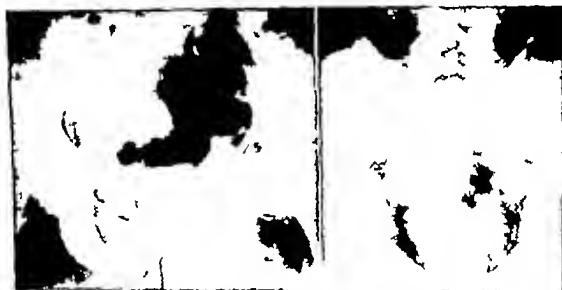


FIG. 236.—Multiple small prostatic calculi (on the left) also numerous calculi (on the right) simulating a single large prostatic calculus.

of a bladder neck obstruction if the calculus impinges upon the urethral lumen. Spontaneous evacuation of the calculi through the prostatic ducts into the urethra may also occur. If infection of an advanced degree is present, perineal or recto-vesical fistulae (Fig. 196) may develop as the result of extension to the peri-prostatic tissues. The diagnosis is based upon (a) the findings on rectal palpation, (b) radiography, (c) exploration of the urethra or fistulous tracts. On rectal examination the prostate is felt to be enlarged, nodular and very hard, simulating very closely the "stone-like hardness" etc. typical of the findings in a case of carcinoma of the prostate (to be discussed later in this chapter) as well as a similar form of stone-like induration, etc. occasionally observed in certain cases of chronic prostatitis to which the term "woody phlegmon" has been applied by Thevenot because of their resemblance to similar lesions on the back of the neck as described by Reclus. If one is fortunate enough to obtain the crepitation due to rubbing on each other of several calculi or can feel the outline of a calculus through a very thin prostatic capsule, rectal palpation may yield much information. Radiography should be employed routinely in all doubtful cases. It will soon disclose the presence of the typical calculous shadows.

Treatment of prostatic calculi

Operative intervention is indicated when they give rise to urethral obstruction, symptoms of recurrent prostatic infection or fistula formation. The method of choice is the perineal route. At times, the calculus may be so large as to necessitate a suprapubic incision, as a primary or secondary procedure. Judd, Parker and Morse (*Surg Clin N A*, 5, 655, 1925) recommend prostatectomy in order to prevent recurrent formation of calculi in the badly infected prostate. We have removed over 1000 small stones from one patient.

INFECTIONS OF THE PROSTATE

In the chapters on Gonorrhea, both acute and chronic prostatic infection due to the gonococcus, have been fully discussed. Attention was called to the fact that prostatovesiculitis is a very common complication and accounted for many of the difficulties in the cure of gonorrhea. In the discussion on Seminal Vesiculitis much of the subject of Infections of the Prostate is also covered. In this chapter we will only take up prostatitis of nongonorrheal origin. This includes

- (a) Infections due to the ordinary pyogenic bacteria
- (b) Tuberculosis of the prostate
- (c) Syphilis of the prostate
- (d) Prostatitis of ordinary pyogenic bacterial origin

There are Three Modes or Routes of Infection

1 **EXTENSION FROM THE PROSTATIC URETHRA** (most frequent of the three) Bacteria normally present in the anterior urethra may become pathogenic and extend posteriorly. Irregular sexual habits, such as coitus interruptus, is a common cause for development of a chronic prostatitis. Also extension downward from a chronic pyelonephritis may invade the prostatic urethra and set up a prostatitis.

2 **HEMATOGENOUS INFECTION**, i.e., metastatic from other foci in the body or during the course of certain systemic infections such as mumps, influenza, typhoid, etc. This is a common source and accounts for 30 to 40 per cent of the cases. Foci in the teeth, tonsils and sinuses are the most common etiologic factors.

3 **LYMPHOGENOUS INFECTION** (by extension from adjacent structures, especially the rectum). This is rare.

In the first of these, the gonococcus is, of course, the primary cause in about ninety per cent of all cases, but in the later stages the ordinary pyogenic organisms (staphylococci, streptococci and the specific organisms of the acute infectious diseases enumerated above) are found. In the third group, the colon bacillus is the chief etiological factor. Clinically, one encounters prostatitis of ordinary pyogenic bacterial origin in two forms, the acute and chronic and we will consider them in this order.

ACUTE PROSTATITIS

From the standpoint of pathologic changes, one distinguishes as in gonorrheal prostatitis, the following

- (a) A catarrhal or glandular form in which there is very marked round celled infiltration of the glandular epithelium, accompanied by its proliferation and desquamation.
- (b) A follicular form characterized by retention of pus and

desquamated epithelium in the individual acini (c) The parenchymatous form in which the inflammatory infiltration extends into the fibromuscular stroma of the prostate and may terminate in a number of tiny abscesses or a larger one (Fig 186) occupying the entire lobe

Symptoms of Acute Prostatitis

These are quite similar to those of the same condition, when it is of gonorrheal origin (see Chap 11) e.g., a feeling of fullness in the perineum and rectum accompanied by burning and pain on urination, urgency (see Chap 10) and even tenesmus. Rise of temperature or chills, may or may not be outstanding features. In some cases they are absent, while in others the picture is that of a generalized sepsis whose symptoms completely overshadow those of the local condition. In acute prostatovesiculitis of hematogenous origin, the onset is usually sudden without a history of urethral discharge.

URINARY RETENTION may occur as a complication of acute prostatitis no matter whether it is of urethral or systemic origin. On rectal palpation, the prostate is found to be much enlarged, tense and very tender. At times, fluctuation or at least softer areas can be plainly felt.

Treatment.

Absolute rest in bed, heat applied to the perineum, hot sitz baths and limitation of the quantity of fluid intake, are essential. The pain on urination and tenesmus are so severe at times, as to require relatively large doses of opiates. We prefer suppositories containing $\frac{1}{2}$ grain each of extract of opium and bella donna. The urine should be alkalized by giving citrate of potassium in thirty grain doses every four hours. The diet should consist chiefly of milk and cereals, avoiding especially all condiments, carbonated waters and acid fruits. If the prostatitis is of urethral origin (postgonorrheal use of dirty instruments, etc.) all local treatment should be discontinued for at least four weeks after subsidence of the acute symptoms.

PROSTATIC ABSCESS

This is a sequel of an acute prostatitis (see Fig 186) and like it may involve either one or both lobes. It may complicate at times a prostatic adenoma (hypertrophy) even when infection has not been a prominent feature of the bladder neck obstruction. Abscess formation may follow an infection of hematogenous or lymphogenous origin as well as an infection in which the primary focus is in the urethra. Spontaneous evacuation of such a prostatic abscess may occur into the urethra (Fig. 186) rectum, periprostatic and perirectal tissues or it may burrow its way toward the perineum.

When fluctuation is evident on rectal palpation, no time should be lost in opening the abscess by the perineal route. The technic of the procedure is taken up in Chapter 49.

CHRONIC PROSTATITIS

The patient with a chronic prostatitis requires attention over a long period of time. The infection subsides only to reappear at intervals. These patients constitute a large portion of those seen in the office practice of the urologist. Many

of the symptoms are discussed under the subject of chronic seminal vesiculitis. This is practically always a prostatovesiculitis, the symptoms of the latter (vesiculitis) often predominating over those of the prostatitis. It is frequently a sequel of a gonorrheal infection, but may result from any long continued irritation or infection of the urethra, due to the ordinary pyogenic bacteria. The prostate on account of its vascularity is well able to take care of infection³ but the seminal vesicles do not possess this property to a very great extent, hence chronic prostatitis is not nearly as common as chronic vesiculitis.

Symptoms These may be classified as follows

1 **THOSE OF URINARY ORIGIN** The spontaneously voided urine contains a variable number of typical short comma-like shreds (Plate VII) termed "Furbringer's hooks." These are more numerous after prostatic massage. There may be pain and burning on urination and quite often phosphaturia.

2 **REFERRED PAIN AND DISCOMFORT** Dull perineal pain or discomfort, itching around the anus, or pains referred to the gluteal regions or thighs, are quite common.

3 **SEXUAL SYMPTOMS** These include premature ejaculation, prostatorrhea, spermatorrhea (especially during defecation), pain on coitus, impotence (partial or complete).

4 **GENERALIZED NERVOUS SYMPTOMS** These vary greatly, and consist of indefinitely localized aches and pains in various parts of the body, headache, generalized weakness, melancholia, etc.

In the average case, very few of the above symptoms are present. As a rule, slight frequency and pain in the perineum or referred to the rectum constitute the chief symptoms in the majority.

Diagnosis

Rectal palpation The prostate feels soft or "boggy" in the milder, or it may feel hard and irregular in the more advanced cases. The third glass, and the expressed secretion after prostatic massage (Fig. 97), reveal the presence of shreds (Plate VII) and pus. There is still much difference of opinion as to the number of pus cells which can be considered pathological, microscopically. In the absence of symptoms, the presence of three or four or even six cells to the high power field can still be considered as normal, after massage.

Treatment of chronic prostatitis Although some urologists (Stutzin) question the efficacy of prostatic massage, there is almost complete unanimity of opinion, that this method of treatment kept up for a period of months, is at present the most valuable. Instillations into the deep urethra (Fig. 111), of mild solutions (one-eighth to one-half per cent) nitrate of silver, or of five per cent silver nucleinate, two per cent argyrol, one half per cent albargin or two per cent protargol or 1-5000 potassium permanganate or a similar strength of acriflavin, can all be employed after the prostatic massage. The latter should not be given oftener than twice a week. Diathermy is of much value in protracted cases when pain is a prominent feature and massage, etc., has given but little relief. Direct

³ See Chapter 41

injection of the prostate with the purpose of causing scarring and shrinking of its tissue appears to us to offer very little of therapeutic value

TUBERCULOSIS OF THE PROSTATE

This is the most frequent point of localization of tubercle bacilli in the genital tract, and is usually associated with tuberculosis of the epididymis and seminal vesicles

This is rare above the age of forty and below that of twenty years. The bacilli reach the prostate in one of the following ways

1 Through the seminal duct (vas deferens) from a primary tuberculosis of the epididymis

2 Through the ejaculatory ducts from a tuberculosis of the urethra. The latter is an uncommon mode of extension from a vesical or renal (primary) tuberculosis

3 Through the blood vessels of the prostate i.e. by the hematogenous route from some distant focus as in renal tuberculosis. In most cases it is probably hematogenous in origin and in some is secondary to tuberculosis of the seminal vesicles. Descending infection along the urinary tract from the kidney is an etiologic factor in a small percentage of cases

Pathology

Often only one lobe, but usually both are involved. The lobes increase moderately in size, the surface becomes nodular and adhesions to the adjacent tissues occur (periprostatis). If the individual larger tubercles caseate the indurated areas show evidence of fluctuation. In some cases healing may occur without caseation by encapsulation and replacement of the tuberculous by fibrous tissue.

Symptoms and diagnosis

The early symptoms resemble those of a chronic non tuberculous prostatitis (see above). A feeling of weight or discomfort in the perineum and rectum especially during defecation accompanied by frequency or in the more marked cases pain on urination or urgency should always lead to the suspicion at least of a prostatitis. Discharge from the urethra is inconstant but the urine is often turbid and occasionally one can find tubercle bacilli.⁴ Terminal hematuria and bloody ejaculations may occur in this form of prostatitis just as in the gonorrheal and ordinary pyogenic forms but neither of these symptoms is constant. The most important method of examination is rectal palpation (Figs. 94 95 96). Here one either feels several sharply demarcated firm nodules or a large single nodule in one or both lobes.

Treatment.

This depends upon whether the infection is primary (hematogenous)⁵ or secondary (to kidney⁶ or epididymis⁷). In both of these modes of infection we are of the opinion that conservative measures are indicated with the object of

⁴ See Chapter 8

⁵ This is rare.

⁶ This is also uncommon.

⁷ This is the usual route

increasing the patients' resistance. The general principles employed in treating pulmonary tuberculosis should be followed as closely as possible. There is almost invariably an associated tuberculous seminal vesiculitis, so that removal of the prostate alone, is of but little benefit. We have observed a number of cases in which removal of the tuberculous epididymis has been followed by healing of the prostatic and vesicular foci. The same is true of those less frequent cases in which the prostatic involvement is secondary to a renal tuberculosis. In some recent cases, we have ligated and divided the vas deferens⁸ on the still noninvolved side, when a bilobar tuberculosis of the prostate complicated a similar infection of the epididymis (after removal of the latter). Radical operations such as prostatectomy or vesiculectomy, for tuberculosis of the corresponding organs, are seldom indicated, but when abscess of the seminal vesicles is present and marked involvement of the prostate also occurs, Young's radical operation for T B of the seminal tract is indicated. We have done 10 of these operations successfully, and have removed the prostate, seminal vesicles, vasa and epididymides of both sides. This is not as formidable a procedure as would appear.

SYPHILIS OF THE PROSTATE

This occurs very seldom and does not give rise to any pathognomonic symptoms, at least in the secondary stage. Gummata have been found in the prostate which gave rise to symptoms similar to those seen in adenoma (hypertrophy) or carcinoma. If one suspects the presence of a syphiloma, as indicated by the history and Wassermann reaction, antisyphilitic treatment should first be given a thorough trial.

HYPERTROPHY⁹ OF THE PROSTATE AND OTHER BLADDER NECK OBSTRUCTIONS

Clinically there is such a complete resemblance of the condition commonly known as prostatic hypertrophy or enlargement, as found after middle life, to other benign pathologic conditions at the bladder neck, that we deem it advisable to consider them together. Although prostatic hypertrophy, contracture of the vesical outlet, median bar formation and other conditions at the vesical neck differ in their pathologic anatomy, yet the changes both in the upper and lower urinary tract which result from their presence, differ only in degree. The same is true of the clinical pictures which they give rise to. We shall see shortly that with the methods at our disposal today, it is possible to make an exact diagnosis of the nature of the underlying bladder neck obstruction or atony, and to be governed in our method of treatment by such findings. We have also learned that certain central and peripheral bladder muscle disturbances of neurogenic origin, can give rise to the same clinical pictures and sequelae as actual mechanical obstruction at the bladder outlet.

In view of the above, we must discard the older teaching that one cause

⁸ This procedure has proven to be of little value because infection of the remaining epididymis occurs by the hematogenous route.

⁹ We have retained the term hypertrophy of the prostate, because it has been employed for such a long period, that it would be confusing to use the terms, hyperplasia of, or adenoma formation in the prostate.

alone, can give rise to disturbances in urination in men or women of middle age or beyond Beer and Hyman as we shall see later have shown that at least one of the causes of chronic retention in older individuals viz., bladder neck contraction can also occur in children

To sum up, we must approach every case giving the history of acute and chronic retention of urine, both in children and after middle life, without a preformed opinion as to the nature of the underlying cause Prostatic hypertrophy will account for the majority but by no means all of the cases.

Causes of dysuria or of acute or chronic retention after middle life

The following must be kept in mind

1 Urethral sources

(a) Stricture¹⁰ (b) calculi and tumors¹⁰

2. Prostatic sources.

(a) Calculi compressing urethra.¹¹

(b) Prostatic hypertrophy (hyperplasia or adenoma formation)¹²

(c) Carcinoma and sarcoma of the prostate

(d) Acute and chronic prostatitis¹³

3 Changes at or close to the vesical neck.

(a) Contracture of the vesical outlet.

(b) Median bar formation

4 Vesical conditions.

(a) Tumors arising from the bladder wall or invading it from adjacent structures.

(b) Calculi impacted in the vesical outlet (see Chapter 26)

(c) Large diverticula occluding vesical outlet (see Chapter 26)

(d) Hypertrophy of the trigone or of the interureteric ligament.

(e) Neurogenic conditions of central (tabes¹⁴ cerebrospinal syphilis etc.) origin

(f) Atony of the detrusor muscle, e.g., senile atony etc.

PATHOLOGY OF OBSTRUCTIVE LESIONS

There are only 3 major pathologic entities that cause obstructions at the bladder neck (Randall) 1 Glandular or prostatic hypertrophy 2 Median bar formation—this includes contractures and sclerosis of the vesical neck 3 Carcinoma We will consider the etiology and pathologic changes of these lesions in the order named

PROSTATIC HYPERTROPHY OR GLANDULAR HYPERTROPHY

Despite numerous painstaking studies little is known regarding the etiology of this condition The most acceptable theory is that it is due to some endocrine imbalance between the pituitary and testis

¹⁰ See Chapter 30 and 31

¹¹ See earlier portion of this Chapter

¹² See later in this Chapter

¹³ See earlier portion of this Chapter

See Chapter 24.

The outstanding feature of prostatic hypertrophy is the formation of nodules, composed of glandular tissue, to which Ribbert has applied the term adenomata¹⁵ Hyperplasia of the glands of the prostate and of those around the vesical neck is in the foreground of all of the changes

Occasionally, instead of the nodules being composed chiefly of glandular tissue, one finds nodules of fibromyomatous nature The glandular proliferation, however, always predominates Jacoby in an examination of over 100 specimens of prostatic hypertrophy, never found a pure fibromyoma

The consistency of the hypertrophied prostate is directly dependent on the proportion of glandular element to that of the fibrous tissue stroma in the

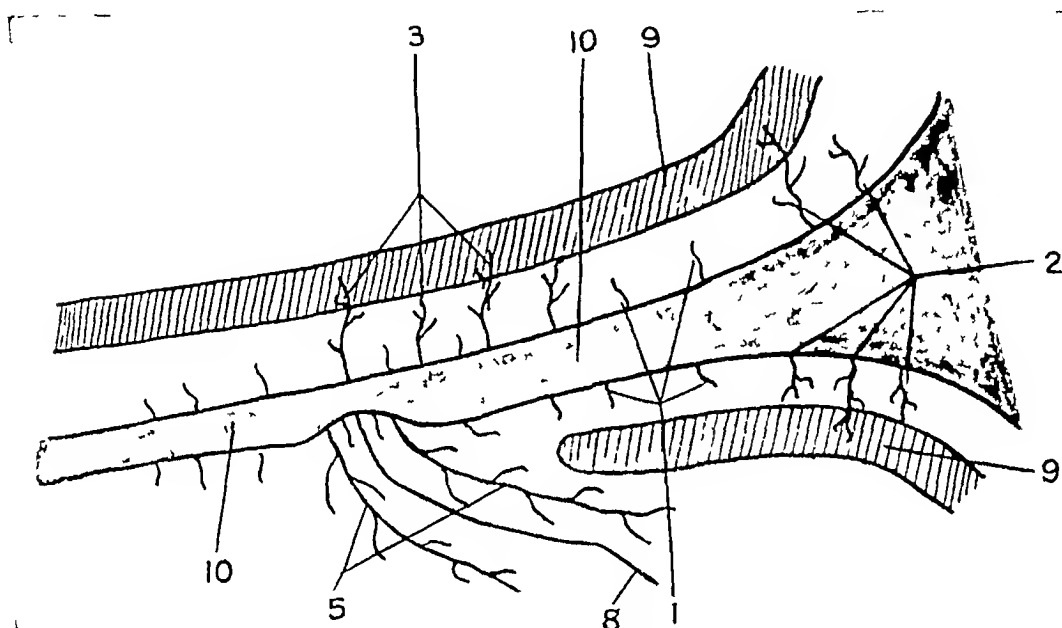


FIG 237—Diagrammatic longitudinal section through a normal prostate (M. Jacoby)

- 1 Glands in mucous membrane
- 2 Cervical group of submucous glands at neck
- 3 Ventral group of submucous glands at neck
- 4 A and B "Urethra" glands (See Fig 244B)
- 5 Peripheral prostatic glands
- 8 Ejaculatory duct
- 9 Internal vesical sphincter in section
- 10 Urethra

nodules If more of the former is present, it is soft, if the fibrous stroma predominates, it is hard

Normal Anatomy In order to understand the point of origin of the nodules, one must be familiar with the glands and musculature of the normal prostate (Fig 57)

THE GLANDS OF THE PROSTATIC URETHRA according to Jacoby (*loc cit*) can be divided (Figs 237, 238), as follows

(a) Those of the mucous (Fig 237) membrane of the urethra These are of no significance in relation to prostatic hypertrophy

(b) Submucous glands These do not occur on the trigone¹⁶ alone as Motz

¹⁵ The majority of pathologists regard the process as a hyperplasia, rather than a neoplasm, i.e., a true adenoma

¹⁶ The term "subcervical" was applied to this group by Motz and Alborran but is little employed at present

and Albarran believed, but also on the ventral and lateral aspects of the vesical neck and are therefore better termed cervical group (Fig 237) They may be absent. A second group of submucous glands is found quite constantly in the distal portion of the ventral (anterior) wall (Fig 237) of the prostatic urethra and can extend well forwards. On both sides of this ventral group there are a number of glands (4A and B of Fig 238) which envelop the urethra almost completely. At times they are separated from the true prostatic glands (5 of Fig 238) by muscular and fibrous tissue while in some specimens they have a common excretory duct (6 of Fig 238) with the true prostatic glands. Ribbert has suggested the term "urethral glands" for these and Jacoby (*loc. cit.*) is of the opinion that the hypertrophied lateral lobes arise from these urethral glands and not from

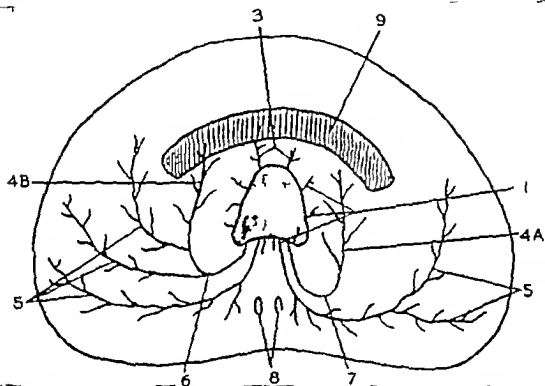


FIG. 238—Cross section (diagrammatic) of normal prostate. (From article by M. Jacoby.) The numbers are the same as in Fig. 244A with exception of 6 which represents the common excretory duct of the urethral (from which hypertrophy arises) and peripheral prostatic glands. 7 represents looped excretory duct of the urethral prostatic glands.

the accessory periurethral which are scattered over the entire prostatic urethra and open directly into it.

GLANDS OF THE TRIGONAL GROUP The pathologic middle lobe (Figs. 239-241 inclusive) arises from the glands of the trigonal group although nodules may also form on the lateral or dorsal aspects of the outlet as well as on the trigone (see 2 of Fig 237). As the nodules develop the true prostatic glands (Fig 57) are displaced and compressed to form the capsule for the hypertrophied prostate. The same hyperplasia which takes place in the "urethral glands" to form the middle lobes can also occur in the still intact but compressed parts of the capsule. This explains why recurrences after prostatectomy are less frequently due to overlooked nodules than to new formation in the capsule itself.

Site of Hypertrophy Microscopically, one sees round areas made up of groups of tubuloacinous glands of varying size surrounded by fibromuscular

tissue The capsule and the septa between the individual nodules contain much more fibrous than muscular tissue The glandular epithelium is arranged in many layers and often with ingrowths or villous projections into the lumen More or less round-celled infiltration is almost always present and abscess formation may occur in such a hypertrophied (really hyperplastic) prostate We shall refer to this again later

Prostatic hypertrophy is in most cases limited to the portion of the prostatic urethra which lies proximal to the verumontanum, i e , it surrounds the supramontane portion, as it is termed However, it is not rare to find the lateral lobes of the prostate projecting anteriorly in front of the verumontanum The ejaculatory ducts lie well away from the hypertrophied lateral lobes, are never included in them, but lie in close relation to the capsule,¹⁷ usually external to it

Types of prostatic hypertrophy

In accordance with the generally accepted viewpoint in respect to the mode of origin of prostatic hypertrophy (really hyperplasia) from the paraurethral (Fig 238) and not from the true prostatic glands, Randall's classification into the various pathologic anatomical types of glandular hyperplasia will be followed This is an improvement on the older classification by Tandler & Zuckerkandl Since the advent of the resectoscope our knowledge of the pathologic anatomy and pathologic physiology of prostatic hypertrophy has increased considerably The indications for either transurethral, suprapubic or perineal approach for the removal of the obstruction are based chiefly on the anatomical type of glandular hypertrophy

Randall's classification This is based on a study of 222 cases of prostatic hypertrophy found at autopsy on 1,215 patients, an incidence of 18.2 per cent In this series they were divided into the following

- 1 Simple bilateral lobe hypertrophy—32 cases
- 2 Solitary posterior commissural hypertrophy, or median lobe—31 cases
- 3 Bilateral and posterior commissural hypertrophy—38 cases
- 4 Solitary subcervical lobe with marked intra-vesical protrusion—the large middle lobe—67 cases
- 5 Bilateral and subcervical or tri-lobar hypertrophy—48 cases
- 6 Bilateral and subcervical and commissural hypertrophy—3 cases
- 7 Anterior commissural lobe—3 cases
- 8 Subtrigonal lobe hypertrophy—3 cases

1 **THE BILATERAL LOBE HYPERTROPHY** is an intraurethral and infravesical hypertrophy—does not distort the bladder neck, and does not protrude intra-vesically When the lateral lobes are large they extend upward, subvesically, raising the floor of the bladder and trigone When small, and with no subvesical protrusion, transurethral resection is indicated When large, perineal approach is best

¹⁷ By "capsule" often termed "surgical" capsule is understood the outer stratum of glands of the normal prostate (Fig 69) which have been compressed as just explained by the hyperplasia of the urethral glands

2 SOLITARY POSTERIOR COMMISSURAL HYPERTROPHY OR MEDIAN LOBE OR GLANDULAR BAR. The floor of the trigone is elevated and there is a moderate intravesical protrusion. These are particularly suited for transurethral resection.

3 BILATERAL AND POSTERIOR COMMISSURAL HYPERTROPHY. The hypertrophy is rather marked. These may be considered border line cases—can be removed either suprapubically or by transurethral approach.

4 SOLITARY SUBCERVICAL LOBE. These are practically entirely intravesical and extra-capsular, protruding into the bladder and pedunculated. When small these are amenable to transurethral resection. However the large subcervical lobe is best attacked suprapubically. One of the contraindications to transurethral approach is the inability to visualize the ureteric orifices cystoscopically.

5 BILATERAL AND SUBCERVICAL OR TRILOBAR HYPERTROPHY. These prostates are large, they protrude intravesically and are best removed suprapubically (Fig. 240).

6 BILATERAL SUBCERVICAL AND COMMISSURAL HYPERTROPHY. These are very large prostates which should be attacked suprapubically. The rare anterior commissural hypertrophy and subtrigonal enlargement are best treated suprapubically.

(a) The intravesical type of enlargement of Tandler and Zuckerkandl includes all except the simple bilateral lobe hypertrophy. This changes the vesical orifice so that it is no longer represented by a simple funnel like depression (Fig. 41) which lies at the same level as the surrounding tissue. The vesical orifice is found to lie either higher or lower depending on whether the intravesical protruding portion of the prostate is developed on the sacral (posterior) or pubic (anterior) side of the orifice. No matter how much the prostatic enlargement protrudes into the bladder its origin is always in the retromontane portion of the urethra especially from those glands which surround (Figs. 237-238) the vesical orifice. The hypertrophy extends inward between the internal sphincter and the epithelial lining of the bladder so that only the latter covers the intravesical portion. This intravesical form of prostatic hypertrophy as stated previously varies greatly both in form and size. In its simplest form it may occlude the internal meatus in a valvelike manner, the pedicle being either narrow or more sessile (Fig. 239). It may surround the orifice in a collar like manner or there may be only a gap at the upper margin (Fig. 241) or the orifice is represented by a vertical slit. The more sessile the intravesical protrusion (Fig. 242) the more is the orifice pushed upwards.

The trigone is raised but not as much as in the subvesical (see later) type of enlargement. There is very often an accompanying hypertrophy of the trigonal muscle and of the interureteric ligament as Young, Hinman and Wesson have pointed out. This results in marked shortening and thickening of the trigone so that it can be lifted up (Fig. 243) from the remainder of the bladder floor. The degree of hypertrophy of the interureteric ridge which accompanies that of the trigonal muscle varies greatly. At times as Hinman and Wesson have shown (Fig. 273) the ridge is brought into close apposition with the vesical neck and there is quite a deep pouch formed behind it.

This hypertrophy of the trigonal muscle and interureteric ligament results from the effort of the trigonal muscle to pull open the vesical orifice when the latter is obstructed (Figs. 239-241 inclusive) by any of the forms of intravesical

protrusion of the prostate The prostatic urethra is greatly lengthened, more in this, than in the subvesical form of prostatic hypertrophy It may be 8 cm instead of 2.5 cm in length The course of the prostatic urethra is also changed The lumen may also be altered so that it is enlarged in a spindle-like manner or narrowed so as to be represented by a simple slit The course of the urethra changes so that the portion proximal to the verumontanum (i.e., the supramontane area around which the hypertrophy chiefly occurs) instead of forming a curve (Fig 46) as in the normal urethra, bears an almost rectangular relation (Fig 242), to the portion distal to the veru This is of great importance clinically, because special catheters (coudé) should be employed, so constructed (Fig 71) that the changed course of the urethra can be followed, otherwise a false passage (Fig 244) through an intravesical protrusion easily occurs

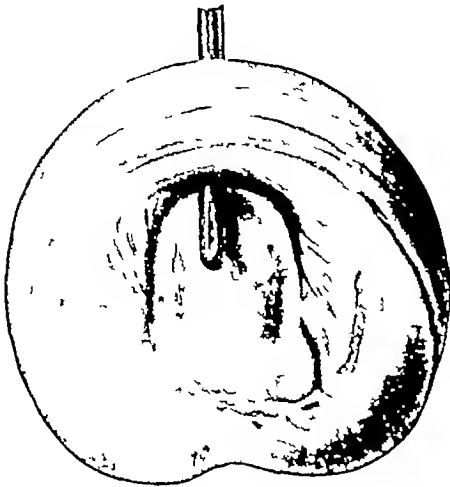


FIG 239—Drawing of specimen after suprapubic prostatectomy showing how a sessile middle lobe obstructs the internal urethral orifice (indicated by catheter) Note presence of lateral lobes forming a ring around the prostatic urethra

(b) The subvesical type of prostatic hypertrophy This raises the floor of the bladder as a whole, but causes no changes in the position of the vesical orifice It does not displace the internal sphincter laterally There is no intravesical protrusion



FIG 240—Two necropsy specimens of large adenomas of the prostate In the left sided specimen the middle lobe is seen to be relatively small as compared to the lateral lobes In the specimen on the right, the middle lobe is chiefly involved with marked trabeculation of the bladder

The vesical orifice (internal meatus) lies at the upper (proximal) extremity of the growth There is less variation in the forms of this subvesical type of hyper-

trophy It surrounds the prostatic urethra in a collar or ring like manner and does not deform the vesical orifice or protrude into the bladder, simply raising its floor The changes in the lumen and length of the urethra are practically the same as in the intravesical type but there is less of an alteration in the course of the urethra

Since the effects both local and systemic of prostatic hypertrophy are quite similar to those due to other forms of bladder neck obstruction the anatomical forms of the latter will be first considered

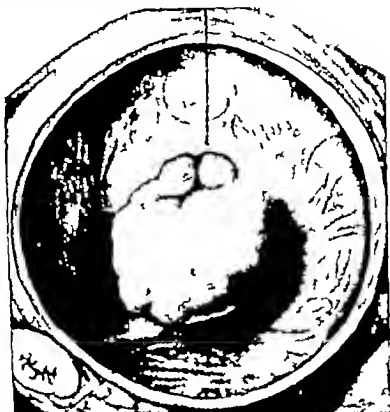


FIG. 241.—Vertical aspect of prostatic hypertrophy illustrating the intravesical (see text) type of enlargement. Note large middle lobe and two hyperplastic nodules on either side of ventral (anterior) edge of internal orifice (Tandler and Zuckerkandl.)

MEDIAN BAR FORMATION

This includes the various end results of chronic inflammation at the bladder neck resulting in fibrous tissue formation with contractures, sclerosis and fibrosis. The true fibrous median bar should not be confused with the so-called glandular bar which is really a posterior commissural or middle lobe hypertrophy. These bars and contractures are found in younger individuals and are usually associated with a chronic prostatitis. Although Guthrie in 1830 first described this as a cause of vesical obstruction the subject received but little attention until 1917 when Alex. Randall reported his observations on autopsy specimens. Since that time Randall, Young, Caulk, Wesson and others have through their contributions to both the anatomic and clinical aspects of the subject aroused great interest in this type of bladder neck obstruction. The abrupt bar or dam (Fig. 245) is composed of fibrous tissue and stretches transversely across the posterior (dorsal or lower inferior) border of the internal urethral orifice. Its edge is sharp and narrow. The bar is only covered by the epithelial lining of the bladder

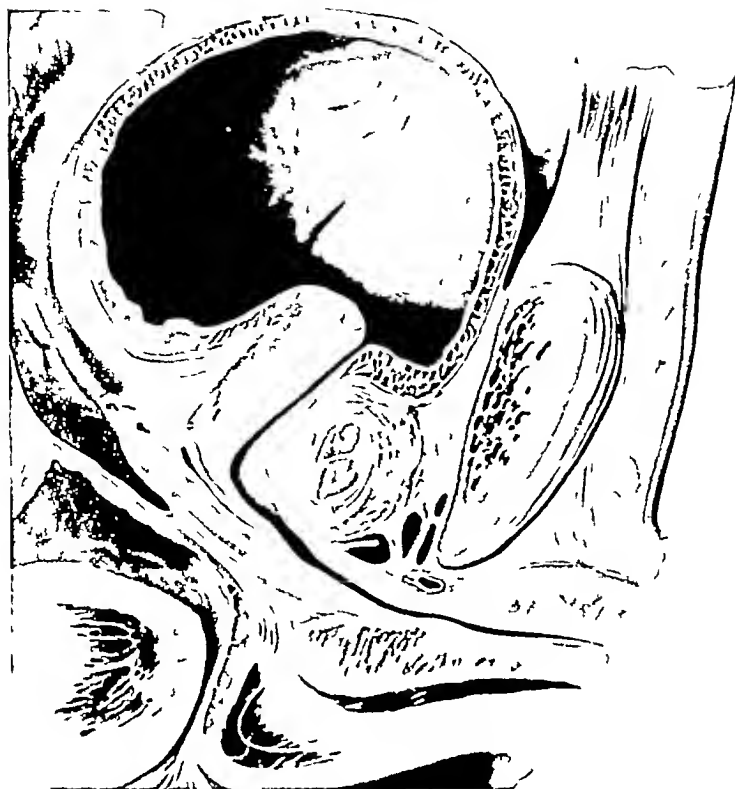
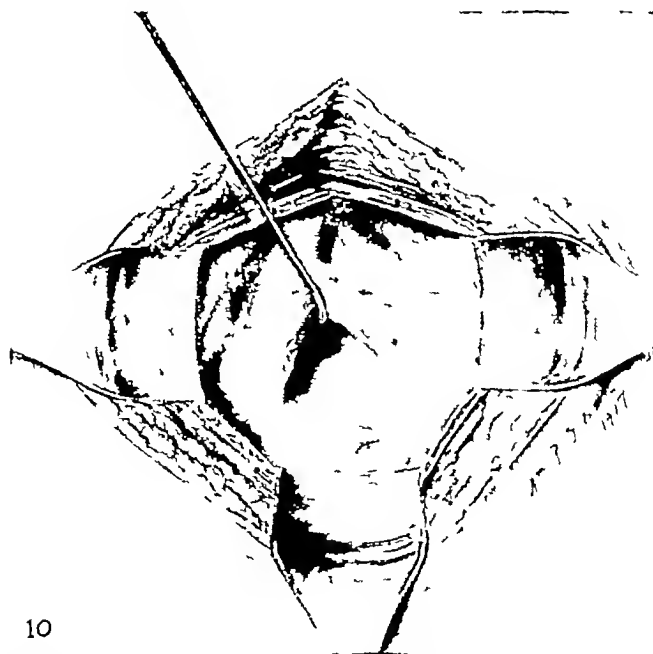


FIG 242 —Sagittal section of bladder showing a deep pouch behind the intravesical type of prostatic hypertrophy Note rectangular course of the prostatic urethra (Tandler and Zuckerkindl)



10

FIG 243 —View from above showing hypertrophied interureteric ligament and trigone lifted by hook Note deep retrotrigonal pouch and normal appearance of internal urethral orifice (Courtesy of Drs H H Young and M B Wesson)

and can block the vesical outlet as effectively as any of the other forms of bladder neck obstructions just described. Median bar formation is frequently complicated by hypertrophy of the trigone and of the interureteric ligament (Fig 243) as well as trabeculation and cellulose formation. Contractures at the vesicle neck are a part of the process of median bar formation and have been described by Buerger who has classified them into 3 types.

1 **Pure fibroses.** Here the replacement of the muscle fibers of the internal sphincter is marked, although there are no signs of inflammation. The submucous fibrous changes may also involve the retro i.e., supramontanum¹⁸ portion of the urethra which is easily understood when one recalls how the fibers of the internal sphincter (Fig 246) form a loop around this portion of the urethra as Wesson has demonstrated.

2 **Fibrosis and Inflammation.** The latter may predominate and result in a rigid perurethral envelope between the verumontanum and vesical outlet.

3 **Fibroses with scattered adenomata (hyperplasia) nodules.** There is a preponderance of fibrosis with but a few insignificant adenomatous nodules so that there is little resemblance to the more extensive collar like involvement of the urethra and vesical neck, at times seen in certain cases of subvesical hypertrophy of the prostate. Clinically, in all of these varieties of bladder neck contracture the tip of the index finger introduced into the internal vesical orifice finds a hard infiltrated annular band or fibrous ring effectually preventing its introduction into the urethra. This infiltration can in some cases be felt to involve the entire prostatic urethra.

These cases of bladder neck contracture may be associated with median bar formation (see below) or occur independently. It may also be accompanied by similar shortening of the trigone (Fig 243) with or without hypertrophy of the interureteric ridge as has been described under prostatic hypertrophy. This will usually disappear according to Young as soon as the bladder neck obstruction has been relieved.

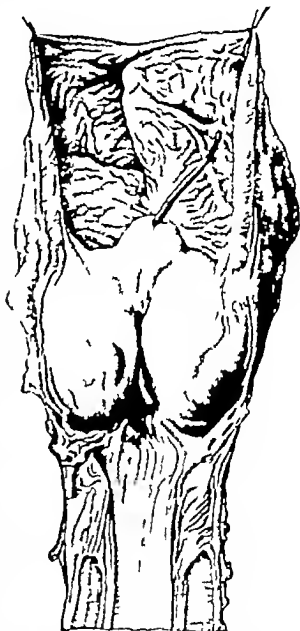


FIG. 244.—Autopsy specimen showing false passage through middle lobe of hypertrophied prostate. (Courtesy of Prof. F. Legueu of Paris.)

¹⁸ Proximal to the verumontanum.

Young,¹⁹ Beer¹⁹ and Hyman have directed attention to a similar condition occurring in children and young adults causing chronic retention of urine

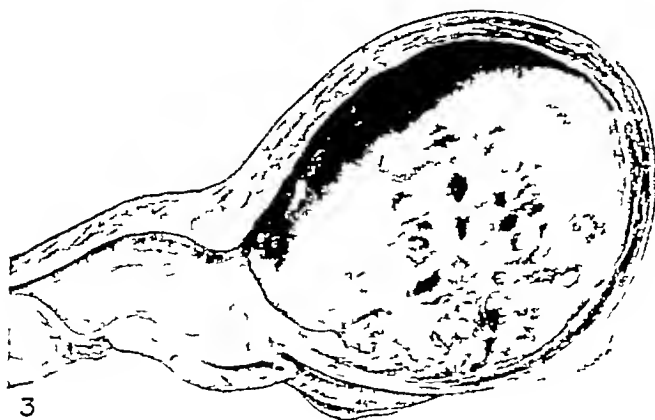


FIG 245—Sagittal section showing median fibrous bar with beginning undermining of hypertrophied trigone. Note marked trabeculation of bladder wall and cellule formation (Courtesy of Dr Miles B Wesson)

It is due either to a muscular hypertrophy such as is seen in congenital pyloric stenosis in infants or to fibrotic changes at the vesical neck. The effects of median

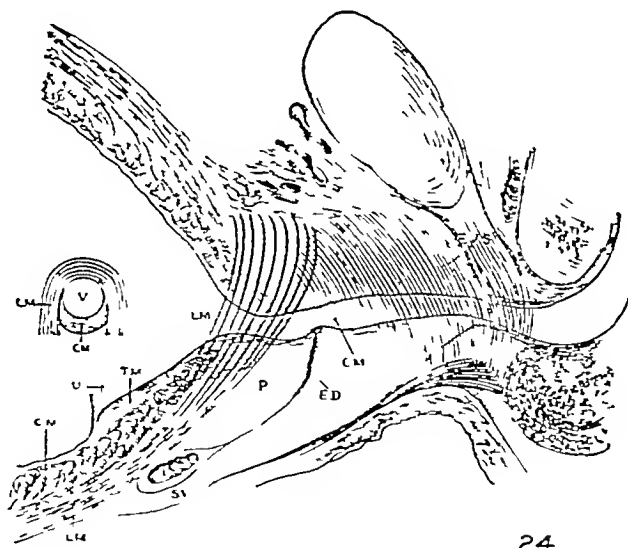


FIG 246—Diagram showing how the external longitudinal layer of the muscles at floor of bladder sweeps up over the vesical orifice making a loop. Within this loop the circular layer forms a wedge below the orifice (insert) and flows down the urethra in an oblique direction surrounding the canal as a thin layer. The result is a double loop and not a sphincter. V Vesical orifice L M Longitudinal muscle CM Circular muscle TM Trigonal muscle EVS External vesical sphincter (striated muscle) Ur Ureteral orifice SV Seminal vesicle ED Ejaculatory duct P Prostate (Courtesy of Dr Miles B Wesson)

bar and bladder neck contracture both in children and adults, do not differ from those observed in prostatic hypertrophy and will be described shortly

Trigonal and interureteric ligament hypertrophy This has been specially studied by Young, Hinman and Wesson. It is due to the effort of the

trigonal muscle to pull open the vesical orifice when there is a median lobe or a bar or similar bladder neck obstruction. The trigone may be extensively undermined (Fig 243) with the formation of a deep pouch. The condition in the opinion of Young is a purely compensatory one and will disappear as soon as the obstruction is removed. Hinman and Wesson believe spontaneous recession will not occur and that operations such as resection²⁰ of the hypertrophied interureteric ligament and of the trigone are indicated.

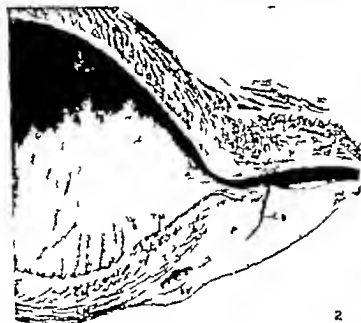
Having described in as brief a manner as possible the anatomic causes of bladder neck obstruction we will next discuss their local and systemic effects.

3. Carcinoma. See Carcinoma of the Prostate p 343

EFFECTS OF OBSTRUCTION

LOCAL EFFECTS

1 Upon the Bladder Wall. At first the walls are much thicker as the result of muscular hypertrophy which reveals itself intravesically by the presence



2

FIG. 247.—Sagittal section through vesical neck and prostatic urethra of normal adult. See legend for Fig 246 (Courtesy of Dr. Alfred B. Wesson)

of trabeculation (Figs 245-248) of varying degree. In the later stages the walls become thinner and the action of the musculature indicates atony of the detrusor with the bladder often reaching to the umbilicus (Fig 173) without the patient being conscious of any retention. The formation of a pouch behind an intra-vesical protrusion of the prostate (Fig 242) or behind a hypertrophied trigone or interureteric ligament (Fig 243) has already been referred to. The inability of the patient with bladder neck obstruction to void the urine (termed residual) which collects in this pouch favors infection.

INFECTION. This may occur by the hematogenous route from the kidneys even when he has never been catheterized. Appreciation of the possible presence of such a pouch and of the resultant residual urine is of the utmost importance

²⁰ See operations on bladder in Chapter 52

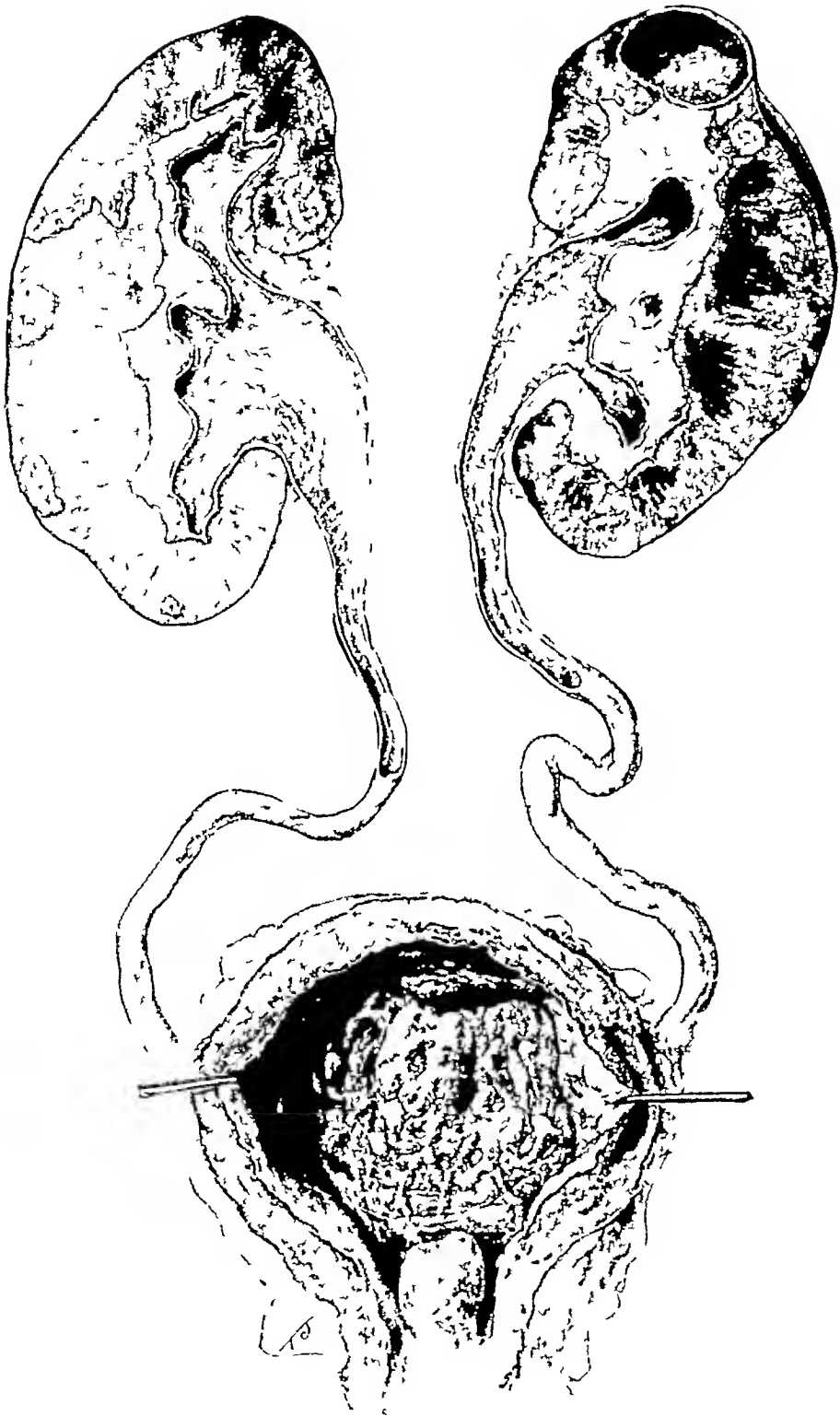


FIG 248—Autopsy specimen illustrating some of the sequelae of bladder neck obstruction due to prostatic adenoma. Note how the large, middle lobe blocks the vesical outlet, only narrow grooves on either side allow urine to escape. Also note marked compensatory hypertrophy of musculature with trabeculation, seen through overlying epithelial lining of bladder. Both ureters and renal pelves are dilated as the result of "back pressure." The renal parenchyma is the seat of a diffuse infection on both sides.

in order to impress upon the patient and those who have the duty of passing catheters, the ease with which infection occurs. This same stagnation also favors the formation of calculi not only in the bladder proper but also in the many shallow pouches, termed false diverticula or better cellules (Figs. 245-248) as well as in the larger²¹ true diverticula which so often complicate a bladder neck obstruction. These cellules are shallow herniations of the bladder wall between the hypertrophied muscle bundles (Figs. 245-248) which latter form ridges termed trabeculae protruding into the bladder lumen to a variable degree. Spontaneous perforation of these cellules may occur or it may follow instrumentation. Cystitis²² either acute or chronic is a frequent sequel of a bladder neck obstruction and the development of neoplasms²³ is also favored by such an obstruction with its resultant stagnation of vesical contents.

2 **Effects upon the Ureters, Renal Pelves and Kidneys.** A glance at Fig. 248 enables one to visualize how the inability to empty the bladder completely and the resultant back-pressure upon the upper urinary tract favors the following

(a) **DILATATION OF THE URETERS** and incompetency of the mechanism which normally prevents the regurgitation of the vesical contents into the ureters. This reflux as it is termed, is a not uncommon complication (Fig. 249) of bladder neck obstructions.

(b) **DILATATION OF THE RENAL PELVES** (Fig. 248) usually bilateral is secondary to that of the ureters and like it, favors not only the infection of the stagnant urine but compresses the renal parenchyma.

(c) **EFFECTS ON RENAL TISSUE** This may be of three types. Hydronephrotic atrophy due to the compression from the contents of the dilated pelvis.

Pyelonephritis²⁴ with formation of foci of suppuration in the kidney itself (Fig. 260) or extension to the perinephritic tissues.

Chronic interstitial nephritis is usually an independent concomitant renal complication and accounts for the diminution of function (see diagnosis) in cases where there is but little anatomic evidence of back pressure.

3 **Complications on the part of the genitalia.** Infection of the seminal vesicles and epididymis occurs in a much larger proportion of cases of bladder neck obstruction than is generally appreciated. They will be referred to later, under preparation of patients for operation.

SYSTEMIC EFFECTS

1 **Upon the blood and body tissues.** The inability of the kidneys to perform their most important function (see Chapter 3 on physiology) of elimination of the waste products of metabolism results in the accumulation of the latter not only in the blood but in the tissues in general. The determination of the degree of nitrogen retention by chemical examination of the blood (see preparation of patients) only gives information of such retention in the blood but not of that in the tissues.

²¹ See Chapter 26

²² See Chapter 25

²³ See Chapter 27

²⁴ See Chapter 44

2 Upon the cardiovascular system This is also a vital factor in determining the question of treatment The damage to the heart muscle, etc., due to the indirect effects of bladder neck obstruction is of the utmost importance (see preparation for operation)

3 Dehydration This may be a direct result of the renal condition complicating a bladder neck obstruction Many cases of bladder neck obstruction eliminate large amounts of urine containing few of the end products of metabolism, with resultant dehydration of the body tissues The dry tongue and skin of chronic retention cases, is a familiar result of such a polyuria

4 Urosepsis Under this heading are included the effects of absorption of toxins from the infected kidneys

They will be more fully described later

CLINICAL PICTURES

The clinical pictures or periods, under which bladder neck obstructions present, can be grouped as follows, and will be considered in this order

- 1 Period of increased desire to urinate (frequency)
- 2 Period of difficulty in emptying the bladder (dysuria)
- 3 Period of more or less retention (acute and chronic)
- 4 Atypical onset (sudden hematuria, etc)

1 Period or stage of increased desire to urinate (a) In typical cases one obtains a history somewhat like this A patient approaching middle age (i.e., about fifty years, in some, not until sixty or even seventy), states that he has observed an increased desire to empty the bladder, at least his attention has been directed towards an organ of which he was scarcely conscious before This increased desire was at first noticed as occurring at night (nocturia) perhaps only at intervals of several days to weeks Whereas in former years he was never obliged to urinate during a period of seven hours or more of sleep, he now is obliged to get up at least two or three, often many more times to void urine In some cases this increased frequency manifests itself only on arising The patient states that he has noticed that upon arising, he apparently empties the bladder as in former years, but that soon afterwards, the desire recurs and he is obliged to void a second or third time at short intervals, and he has also noticed that the quantity voided at these periods, was equal to or even larger than at the first urination The total output in the twenty-four hours is not increased, i.e., there is no polyuria

This increased frequency gradually extends over the waking hours until this symptom becomes the predominant feature of his daily life and he consults a physician as to the cause of this frequency In atypical cases this first period or stage may be absent and the complaint (see Chapter 10) is that of one of the other modes of onset to be enumerated next

2 Period of difficulty in emptying the bladder (dysuria) After an interval of months to years of increased desire to urinate especially at night or upon arising, in some cases, in others, without such a history, the patient notices that increased effort²⁵ is necessary to empty the bladder Quite frequently this

²⁵ He may notice that he is obliged to use the abdominal muscles to start the stream or completely to empty the bladder

is complained of as having been first noticed upon arising. There is an absence of force in the stream and even after apparently having emptied the bladder completely the desire and increased difficulty reappear after a short interval. This dysuria may disappear spontaneously for a few weeks to even months, and then recur to such an extent that the patient's attention is again attracted to it and he asks for an opinion as to its cause.

3. Period of acute or chronic retention. Under Physiology (Chapter 3) attention was directed to the fact that in cases of obstruction at the bladder neck, a smaller quantity (50-100 cc.) than normal (250-300 cc.) of urine in the bladder suffices to give rise to the desire to void. This serves to explain why such patients have frequency. In some this constant effort of the detrusor muscle results in its hypertrophy and finally to a lack of tone (atony). This inability to empty the bladder completely is due partly to (a) the mechanical obstruction, no matter whether the latter is in the urethra (stricture) or at or near the vesical outlet (Fig. 251) and to (b) the atony of the detrusor muscle. We shall see later (under Diagnosis) that this factor alone (neurogenic or senile atony) may give rise to the same symptoms without a mechanical obstruction.

Chronic Retention. The patient has now reached the stage of chronic retention with all of its sequelae outlined under anatomical changes. In some cases the symptoms due to back-pressure (Fig. 248) without an accompanying infection stand out in the clinical picture. Often the bladder can be palpated (Fig. 173) above the pubes, but as a rule in addition to the complaints of being obliged to urinate more frequently in smaller amounts than normal and with much more effort each time one can observe the systemic effects of faulty elimination in the form of dry skin and tongue, lethargy, a feeling of weakness, thirst, lack of appetite and inability to perform the daily tasks with the same degree of energy as formerly.

If there is an accompanying cystitis or calculi there is more or less burning even pain on urination or slight amounts of blood in the urine. If larger diverticula³⁷ are present, the history is often that of the urine being voided with difficulty during the first effort to empty the bladder, the urine being fairly clear then the desire recurs and a relatively larger quantity of much more turbid urine is evacuated.

The urine remains clear in this stage of chronic retention until infection occurs from within (hematogenous route) or after the use of improperly sterilized catheters, etc. When infection supervenes in a case of bladder neck obstruction the clinical picture changes in direct ratio to the virulence of such a complication. In some the symptoms of acute urosepsis dominate in the form of cycles of chills, fevers and sweats at irregular intervals accompanied by the above outlined symptoms of frequency, dysuria, etc., and the urine contains many pus cells and bacteria (staphylococci, streptococci, *Proteus vulgaris*, *B. coli*, etc.). If the infection is of a less virulent character the symptoms of subacute or chronic urosepsis accompany the local bladder symptoms, often overshadowing them because of the systemic toxemia. These symptoms of chronic urosepsis differ but little from those of back pressure, i.e. of renal insufficiency. In addition to symptoms such as dry tongue, dry skin, lack of appetite, lethargy, ema-

³⁷ In some there is a marked polyuria as the result of an accompanying chronic nephritis, usually interstitial.

³⁸ Amount of urine obtained on catheterization, after patient has voided spontaneously.

ciation, etc., there is almost constantly, a persistent rise of temperature, especially towards evening (to 101-102 F or even higher) If the infection spreads, as we have observed in some cases, to the perirenal tissues, the local evidences of an abscess formation around the kidney (see Chapter 45) may predominate

The degree of bladder neck obstruction is not always a criterion of the severity of the symptoms in this stage of chronic retention. In other words, a small middle lobe or median bar (Fig 245), or contracture of the bladder neck, may give rise to as severe symptoms as a relatively large prostate

In general, the amount of residual²⁷ urine is a fair measure of the degree of renal impairment (Young). A residual of over 400 cc signifies that danger from this source impends. If this residual contains many pus cells, and has an offensive odor, due to urea decomposing organisms, there is added danger of infection of the upper urinary tract, often as the result of reflux (Fig 249)

In the preceding description, the salient features, so far as symptomatology is concerned, of chronic urinary retention²⁸ have been outlined. The objective findings such as blood changes, examination of prostate, bladder, etc., will be taken up under Diagnosis

Acute Retention In some patients, symptoms such as frequency, dysuria or the sequelae of chronic retention, are either absent or they were not sufficiently marked to attract attention and cause the patient to consult a physician. In such cases the onset of urinary symptoms may appear in the form of one or more attacks of acute retention, with a few milder symptoms, such as slightly increased frequency and difficulty in voiding, in the interval

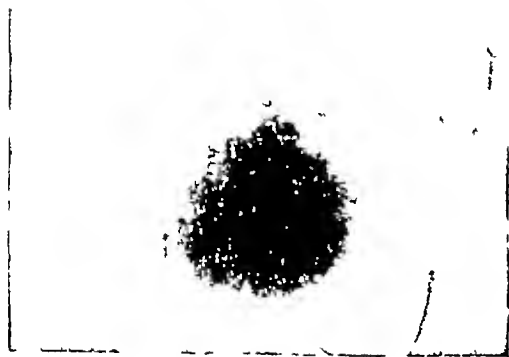


FIG 240—Cystogram from case of bladder neck obstruction due to hypertrophied prostate. Note irregular outline of bladder shadow due to multiple cellules. Also note reflux of opaque medium into both ureters

During the attack of acute retention, the patient suffers greatly from the constant desire to urinate and his mental state, upon noting that he is unable to do so over a period of hours to days, is correspondingly depressed. The bladder becomes distended until it reaches the umbilicus (Fig 190) and there is often accompanying tympany as the result of the inability to pass flatus. With the gradual increase in quantity, of the bladder contents, there is a corresponding decrease in amount of urine secreted, so that the vesical distention does not increase as rapidly as at first. After the bladder has been emptied (see Treatment), the ability to void spontaneously may appear and no further difficulty be experienced until another attack of acute retention appears. This is often the result of the subsidence of the acute congestion which has aggravated the pre-existing obstruction, especially so in hypertrophied prostate cases. Some patients

²⁷ Amount of urine obtained on catheterization, after patient has voided spontaneously

²⁸ In Chapter 10 this was explained as the term applied to the amount of urine remaining in the bladder after apparently complete emptying

are not so fortunate and the retention continues in spite of attempts to treat the case conservatively (see Treatment)

4 Cases in which a severe hematuria is the first symptom. The physician may be consulted for the first time on account either (a) of the passage of a large amount of liquid or clotted blood with every urination, or (b) there may be inability to pass more than a few drops of bloody urine and the bladder be found as in acute retention (see above), to be distended, well above or even to the umbilicus. There may be a history of previous attempts to relieve a chronic retention by instruments but the condition can occur even when no instrumentation has preceded the attack.

Upon passing a catheter in these cases only a relatively small amount of urine is obtained and with it much liquid and clotted blood. In spite of passing a catheter the suprapubic tumor (Fig 190) decreases but little in dimension and such findings should lead to the suspicion that one is dealing with this fourth variety of clinical picture of bladder neck obstructions. It is most apt to occur in cases of intravesical protrusion of the prostate (Figs 246 to 251 inclusive). We have observed such massive hemorrhages not only when there was a relatively small middle lobe but also when there was a large intravesical protrusion. Recently a patient whose first symptom of bladder trouble was such a massive hemorrhage with retention was found on suprapubic exploration to have an ulcerating prostatic cancer.

DIAGNOSIS

The routine preliminary examination consists of, (a) the clinical history (b) observations as to the general appearance, etc. of the patient (c) rectal palpation (d) and the determination of the amount of residual urine and its character. With more careful study of these patients by the use of the various diagnostic resources at our command urologists have been able not only to greatly reduce the mortality but also to have a far greater percentage of satisfactory end results. It is with this idea in mind that the question of diagnosis will be approached.

We do not wish to be understood as insisting that all of the methods to be enumerated should be applied in every case. As in other fields of medicine individualization is indispensable.

As experience in dealing with prostatics and other forms of bladder neck obstructions etc. increases it will become evident to the urologist that he should be familiar at least, with all of the diagnostic methods which are at his disposal for application in suitable cases. Clinically one encounters cases of bladder neck obstruction at least after middle life, under two conditions

1. Emergency Cases.

Those which may be termed emergency cases and require immediate relief without much time being wasted in attempting to make an exact anatomic diagnosis

(a) In this group one may include cases of acute retention whether due to urethral stricture or a bladder neck condition

(b) The cases of massive bleeding into the bladder described above under clinical pictures, as occurring at times in cases of prostatic hypertrophy

(c) Cases of bladder neck obstruction complicated by a severe cystitis or symptoms of pyelonephritis (Fig 248) such as chills, fever and other evidences of urosepsis

(d) Cases of prostatic enlargement complicated by suppuration in the hypertrophied lobes

In all of these, our duty is to relieve the acute condition and postpone a more detailed study until a quiescent stage has been reached

2 Cases of election

This group includes the majority of patients suffering from symptoms of bladder neck obstruction. In these patients, the diagnosis is based upon the following two factors

A The clinical history

B The results of what is termed Urologic Study (see Chapter 10)

A The Clinical History The importance of a complete history of the case as outlined in Chapter 10 (Urologic Study) cannot be overemphasized. Although it yields little information as to the exact nature of the obstruction and the degree of resulting damage, it is of great value in determining the length of time²⁹ during which there have been symptoms of disturbance of urination, whether attacks of acute retention, etc., have subsided spontaneously or were relieved by catheterization, whether hematuria, pain on urination, etc., have been prominent features, whether symptoms of upper urinary tract infection have been present and other data, which are indispensable from a diagnostic standpoint. The importance of a history of syphilis or of neurologic symptoms (extravesical) pointing to disease of the central nervous system, is self evident to those who have had occasion to observe the similarity in symptoms of a tabetic bladder and those due to a genuine obstruction at the bladder neck. Age is no longer to be considered in excluding the possibility of frequency, dysuria, retention, etc., in childhood being due to bladder neck obstructions, since Beer, Hyman and others have directed attention to chronic retention at that period of life being due to contracture of the vesical orifice.

Both this latter condition and median bar formation are observed in much younger individuals in our clinics today than was formerly thought to be the case. In other words, we have learned that prostatic hypertrophy although it accounts for the majority, does not explain every case giving the clinical history of the various stages previously outlined, so typical of cases of bladder neck obstruction.

The diagnosis cannot and should not be made upon the history of the case alone. An evaluation of the results of the various steps to be enumerated next, and of the urologic study, taken in conjunction with a careful history, should be our routine procedure, at least in cases of election (see above).

B The Urologic Study This includes all of the steps whose aim is to give information not only as to the character of the bladder neck obstruction but also as to how advanced the local and systemic changes are. Much of the information obtained is of the utmost importance in the preparation of the patient for an operative procedure and also serves as a guide for the determination of the treatment of the case. For these reasons, repetition will be avoided by giving most

²⁹ Young found that the average duration of symptoms in a large number of cases was over seven years.

of the steps somewhat in detail here. The sequence which we follow in the examination of our cases follows:

1 **EXAMINATION OF THE CARDIOVASCULAR APPARATUS** This includes determination of the blood pressure and search for evidence of valvular or myocardial disease supplemented by electrocardiography as a routine measure. Willius of The Mayo Clinic has directed attention²⁰ to the valuable information one obtains from routine electrocardiographic observations in prostatics, as to the part which cardiac disturbance plays in patients who may be subjected to operation.

2 **EXAMINATION OF THE CENTRAL NERVOUS SYSTEM** This should at least include the condition of the pupils, reflexes and the Romberg test in order to avoid overlooking some neurologic lesion²¹ such as tabes, cerebrospinal syphilis etc., as the underlying factor in a patient with disturbances of urination. It cannot be denied, as stated above, that an organic disease of the central nervous system such as tabes may coexist with an anatomic change causing obstruction at the bladder neck. Fortunately this combination is uncommon and the recognition of both conditions presents no special difficulties.

3 **EXAMINATION OF THE BLOOD** This should at least include (a) determination of the urea and creatinin content,²² (b) The coagulation time (c) Wassermann test.



FIG. 250—A. Large calculus blocking outlet of right renal pelvis complicating a case of marked hypertrophy of the prostate.

B. Pyelogram of same case confirmatory of diagnosis of renal calculus and also showing dilated calices at upper pole.

4 **OBSERVATION OF THE RELATION OF THE AMOUNT OF FLUIDS INGESTED TO THE AMOUNT EXCRETED** during a period of twenty four hours. This is, of course, a portion of the examination which can only be carried out while in a hospital so that this is omitted unless the patient is first seen in our service.

5 **THE GENERAL CONDITION OF THE INDIVIDUAL** This includes the inspection of the tongue, skin, etc., the mental condition, presence of fever and all similar findings which throw light on the degree of intoxication from retention of end products of metabolism in the blood and tissues as well as the effects of any toxemia due to an infection of the upper or lower urinary tract.

²⁰ Jour. Urol. 13, 337, March, 1925.

²¹ See Chapter 28.

²² See Chapter 8 and preparation of patients for operation, later.

6 THE EXAMINATION OF THE GENITO-URINARY TRACT which embraces

(a) SEARCH FOR PRESENCE OF ALBUMIN, SUGAR, CASTS, PUS, BLOOD AND BACTERIAL CONTENT, IN THE URINE

(b) PLAIN RADIOGRAPHY OF THE URINARY TRACT This will at times reveal the presence of renal (Fig 250), ureteral or vesical calculi which might influence the prognosis of a case

(c) RADIOGRAPHY OF THE OSSEOUS SYSTEM This is superfluous unless the findings on rectal palpation lead one to be suspicious of malignant changes in the prostate³³ Radiography should be done as a routine measure in all cases

(d) EXAMINATION OF THE EXTERNAL GENITALIA as to size of the meatus, condition of the epididymis, etc

(e) RECTAL PALPATION This includes the determination of the size, consistency and mobility of both lobes of the prostate We shall refer to this again

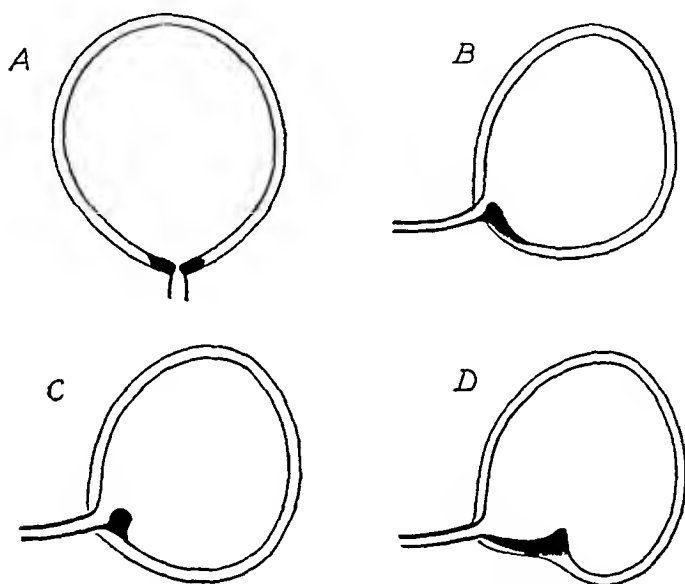


FIG 251—Diagrams of various bladder neck obstructions

A Contracture (fibrous) in collar form of vesical outlet and prostatic urethra (See text under Diagnosis)

B Median bar formation

C Small middle lobe

D Hypertrophied trigone and interureteric ligament with deep pouch behind it

under differentiation from carcinoma The normal seminal vesicle is not palpable, but one should always try to palpate as high above the prostate as possible in order to ascertain whether any enlargement of the vesicles exists

The size of the lobes of the prostate on rectal palpation is not a criterion as to the degree of their protrusion into the bladder³⁴ (Figs 239 and 241) In contracture of the vesical outlet as well as in median bar formation, the prostatic lobes may not be changed in size or consistency on rectal examination A marked enlargement, however, of one or both lobes of the prostate as felt through the

³³ In the prints shown in Fig 171 a man of sixty-eight complained only of frequency and pain in the back. Radiography revealed diffuse metastases in the vertebrae and pelvis due to a primary prostatic cancer

³⁴ Young found that rectal palpation results were correct in only thirty-nine per cent of the cases

anterior rectal wall (Figs. 94 to 96) is of great value in the diagnosis of a prostatic hypertrophy as the cause of the obstructive symptoms

The consistency of the hypertrophied prostate is slightly firmer than that of the normal organ i.e., moderately soft, but it is never the stony like hardness of the malignant prostate (see later)

(f) TESTS OF THE FUNCTIONAL CAPACITY OF THE KIDNEYS They will be referred to under preparation for operation

(g) EXAMINATION OF THE ABDOMEN This should be made routinely in order to avoid overlooking a tumor of the kidney and also to ascertain the degree of chronic vesical retention as determined by suprapubic dullness and palpable tumor (Fig. 173)

(h) EXAMINATION OF THE URETHRA AND BLADDER. This is carried out in the following order

(1) Insertion of a catheter (after having the patient urinate) in order to ascertain the amount and character (odor pus cell and bacterial content) of the residual²² urine Introduction of a bulbous bougie (Fig. 74) into the urethra in order to exclude a stricture This will be taken up again under differential diagnosis

(2) Inspection of the prostatic urethra, vesical neck, interior of bladder and ureteral orifices with a cystourethroscope (Fig. 115) A few urologists still oppose this step of the examination for diagnostic purposes The majority of urologists however feel that without such direct inspection one is unable to determine (a) the type of obstruction which is our best guide to the method of treatment (b) the presence of trabeculation indicating the degree of hypertrophy of the detrusor muscle and often of assistance in determining (as first pointed out by Koll) the presence of tabs (c) the presence of shallow (cellules) or larger diverticular orifices (Plate VIII) (d) the presence of vesical or diverticular²³ calculi (e) the presence of tumors of the bladder which may coexist with a bladder neck obstruction and (f) the appearance of the ureteral orifices, i.e., whether normal or edematous the latter indicating infection (pyelonephritis) of the upper urinary tract and finally (g) the degree of cystitis present

We do not wish to be understood as recommending urethroscopy as a method of diagnosis except in those cases, in which all of the conditions enumerated as emergency ones, are eliminated.

In prostatic hypertrophy urethroscopy gives invaluable information as to the extent to which the urethra (prostatic) is compressed by the lateral lobes and also as to whether an intravesical protrusion is due to the middle lobe alone (Figs. 239 and 241) or to the lateral lobes alone (Fig. 250) or to a trilobular hypertrophy

In median bar formation one sees a transverse ridge or bar extending across the inferior portion (Fig. 245) of the vesical neck In contracture of the vesical neck there are few cystoscopic findings as compared to the other types One finds a greatly narrowed rigid orifice (vesical) with shortening of the trigone trabeculation, cellule formation, etc. all indicative of obstruction at the outlet In hyper

²² This is the amount which is retained in the pouch behind the obstruction after the patient has voided spontaneously

²³ Radiography may be negative for certain vesical calculi, yet they can be seen cystoscopically A calculus in a diverticulum may be visible in the plain radiograph and yet not be seen cystoscopically (See Fig. 313)

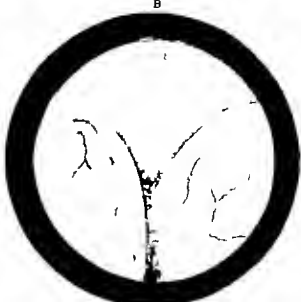
PLATE VIII

- A Intravesical protrusion of middle and right lateral lobes in a case of hypertrophied prostate (Joseph)
- B Marked intravesical protrusion of both lateral lobes of hypertrophied prostate (Joseph)
- C Phosphatic calculi and marked diffuse reddened mucosa (chronic cystitis)
- D Marked trabeculation with cellules (false diverticula) between trabeculae (Joseph)
- E Opening of true bladder diverticulum (Joseph)
- F Middle lobe of prostate and phosphatic deposits (Joseph)

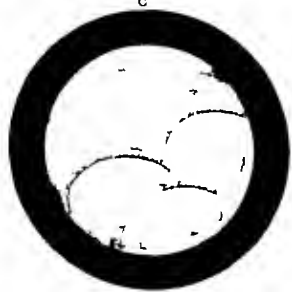
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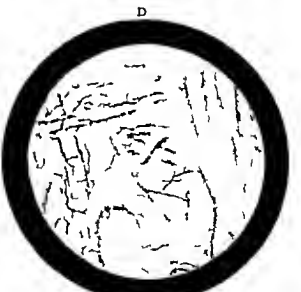
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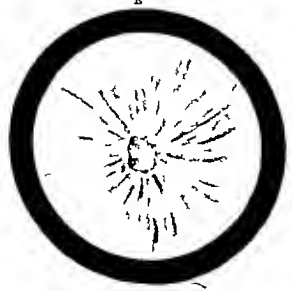
C



D



E



F



and there is more apt to be hematuria at intervals. If the calculi are small they cannot be felt on rectal examination but if there is a single large one a well localized area of stony hardness is to be felt. If there are multiple large calculi there is a crackling sensation on rectal palpation. In doubtful cases, radiography will clear up the situation.

Prostatic Abscess. This may follow an acute prostatitis or complicate a prostatic hypertrophy. Le Roy⁴¹ has recently collected all the cases of suppuration complicating prostatic hypertrophy. The routes of infection are (a) from the urethra, (b) from the rectum by way of the lymphatics (c) after false passage or lithotomy (d) hematogenous.

There are two clinical forms. In the acute the clinical picture is that of a prostatic abscess⁴² and they should be treated by perineal drainage. In the chronic form the suppuration may either occur in the hypertrophied lobes or in the displaced gland tissue (surgical capsule). In this form the condition is often overlooked. One should suspect its presence if fever is present in a case of prostatic hypertrophy and the urine is clear. In afebrile cases, the expression of pus in a case of hypertrophied prostate following massage is characteristic. One should always operate such cases in two stages.

Urethral Stricture. At first glance, a differentiation should not be difficult. One must remember first that a urethral stricture at or close to the bulbomembranous junction (Fig 193) may simulate clinically all of the types of bladder neck obstruction previously described. Secondly, the two conditions may coexist. Andre⁴³ in a series of 300 cases of prostatic hypertrophy found urethral strictures in twelve the calibers of which varied from 15 to 18 F. They usually responded to dilatation. We recall several cases in which it was necessary to treat a stricture before an examination could be made of an accompanying bladder neck obstruction. Symptoms of stricture usually appear earlier in life than at least one of the types of bladder neck lesions (prostatic hypertrophy) but median bar and neck contracture can appear at the same period of life as urethral stricture. Differentiation is not difficult if one notes the point at which the bulbous bougie encounters resistance and combines this if possible, with a posterior urethroscopy.

Vesical Calculus. This may also closely simulate clinically a bladder neck lesion but is more apt to be accompanied by hematuria and pain on urination. The diagnosis of its presence is usually made during the examination of a case of suspected bladder neck obstruction.

Atony of the Detrusor Muscle. This may be of three fold origin viz senile, idiopathic and neurogenic (central nervous system lesions). They may all simulate bladder neck obstructions so far as the two symptoms, difficult urination and chronic retention are concerned. By senile atony is meant a condition not uncommonly seen in poorly nourished asthenic elderly individuals of both sexes, who present the above symptoms without any objective findings. We have applied the term idiopathic atony to the group of cases in which dysuria and chronic retention are found in much younger individuals than is the case with the various types of bladder neck obstruction which we described earlier.

Neither a mechanical obstruction nor a disease of the central nervous system

⁴¹ Jour d'Urol, 23 388 (April and May) 1927

⁴² See earlier portion of this chapter

⁴³ J d'Urol, 21 374 (April) 1926

are demonstrable Moore of The Mayo Clinic found that in twenty-three per cent of so-called "cord" bladders, no lesion of the central nervous system could be found Thompson-Walker described similar cases These cases of apparent idiopathic atony are most frequently seen in younger persons and urethrocystoscopy fails to reveal any obstruction Possibly the condition is a congenital one, analogous to the anomalies of peripheral nerve supply, which serves as an explanation for cases of dilatation of the ureter (see Chapter 29) observed in the fetus and shortly after birth

The true "cord" bladder is most commonly a complication of tabes, less often of other spinal lesions (see Chapter 28)

The tabetic bladder may occur as an independent condition or be associated with a prostatic adenoma The presence of residual urine and difficulty in starting the stream, is a picture commonly presented by both a tabetic bladder and by prostatic hypertrophy or by either The question of whether one or both are present can only be determined by a thorough neurologic and urologic examination Koll was the first to call attention to the more delicate nature of the trabeculation in early tabes than in the same stage of bladder neck obstruction

Cancer of the Prostate The differentiation of this condition from benign hypertrophy will be taken up at the end of this chapter

TREATMENT

Clinically, one sees cases of bladder neck obstruction (especially those due to prostatic hypertrophy) under two conditions

- 1 As emergency cases requiring immediate relief
- 2 As cases of election in which one may choose between the various types of operation, suprapubic, perineal or transurethral, also, nonoperative measures may be best suited for certain cases

Let us consider these separately

EMERGENCY CASES

Those seen during an attack of acute retention Such an emergency is often the result of exposure to cold, sexual or alcoholic excess or postponement



FIG 252 —Bicaude (double elbow) silk woven catheter for use in prostatitis who are difficult to catheterize on account of a large middle lobe (See Fig 241)

of the act of urination for a long period The patient suddenly finds himself unable, even with the aid of his abdominal muscles, to urinate The feeling of discomfort is so great that he is often seen for the first time after numerous unsuccessful attempts have been made to relieve the condition by catheterization

Hot sitz baths, heat to the perineum, enemas and suppositories of opium and belladonna are of great help here

THERE ARE TWO METHODS OF TREATMENT OF SUCH A CASE (a) to empty the bladder completely, as soon as one has succeeded in catheterizing the patient, and (b) to allow the urine to escape gradually, so that the kidneys, etc., can adjust

themselves to the sudden relief of back pressure. Although some urologists do not hesitate to follow the method first named, i.e. to evacuate the bladder at the first sitting, we believe that the second or gradual decompression method as it is termed is the safer procedure for the majority of cases of acute retention.

We have at our disposal the following types of catheters (already referred to in Chapter 5) which we shall enumerate in the order in which we feel they should be used⁴⁴ until one succeeds in entering. Every well equipped urologist's office and hospital service and even a general hospital should possess the following:

Soft rubber catheters with solid tips (i.e. the ordinary Nélaton catheter (Fig. 74).

Soft rubber catheters with hollow tips (Wishard catheters) (Fig. 75) which can be threaded over a mandrin or stylet (Fig. 113).

Soft rubber catheters with coudé (elbow) tips (Fig. 75).

Soft rubber catheters with olive tips (Fig. 75).

Woven silk catheters with a coudé (Fig. 79) or a bicoudé (Fig. 267) end so as to follow the almost rectangular course of the urethra (Fig. 251) in prostatic hypertrophy and to hug the roof of the urethra where the prostate does not impinge.

Metal catheters⁴⁵ with the ordinary Van Buren (Fig. 72) or a coudé (Mercier or elbow) curve (Fig. 72).

After thorough cleansing of the external genitalia and sterilization by boiling of the above catheters we begin preferably with one of the catheters of the soft rubber variety and if these are not successful with one of the woven silk variety leaving the metal catheters until the others have been unsuccessful.

One must always lubricate the catheter well and follow the anterior wall of the urethra as closely as possible without the use of any force. The steps of passing a catheter are practically the same as those described in Chapter 5 for the passage of a sound or metal catheter (see Figs. 99 to 105 inclusive). It is very easy to make a false passage, i.e., penetrate the prostate (Fig. 244) if too much force is used, or one is not equipped with an instrument having the proper curve at its tip. As soon as the catheter has entered the bladder and urine begins to escape one is confronted with the problem mentioned above, i.e. immediate and complete as compared to gradual evacuation. Although there may be no ill effects from the former we believe that it is far safer to employ some type of decompression apparatus as first suggested by Van Zwalenberg and modified by Young, Bumpus and others or to attach an artery forceps or pinchcock to the distal end of the catheter and allow an ounce to escape every half hour until the bladder has been completely emptied. An immediate complete decompression (evacuation) may be followed by suppression of urine or a severe hematuria which is the result of the acute renal congestion. The sudden fall of blood pressure as O'Connor has shown is also a serious complication of such a rapid emptying of the bladder. As soon as the acute retention has been relieved⁴⁶ the further treatment does not differ in principle from that presented by cases which we have termed those of election.

⁴⁴Suprapubic puncture of the distended bladder should be employed as a last resort in our opinion.

⁴⁵These should not be employed, except as a last resort on account of the danger of false passage.

⁴⁶The catheter should be left in place after having been attached to the penis as shown in Figure 109.

Cases seen with massive hemorrhage into the bladder. Aside from the passage of liquid and clotted blood with a small amount of urine, these cases (see Symptoms and Diagnosis) differ little from those of acute retention. The bladder usually reaches to the umbilicus (Fig 173) and is filled with blood. Even though one has been successful in entering the bladder with a catheter, the eye of the latter may be rapidly occluded by a blood clot. Every effort should be made to wash out some of the clotted and liquid blood in the bladder and to reapply the inlying (Fig 106) catheter. If, in spite of every such effort, the bladder continues to fill with blood, only a suprapubic cystostomy (see Chapter 52) will relieve the condition, so that the case can be "tided over" into the stage of election. We have encountered massive hemorrhages of this variety (a) in a greatly congested middle lobe, (b) in a case of ulceration of the vesical aspect of a prostatic cancer, and (c) in a case in which a calculus lying behind a relatively small middle lobe had caused a decubital ulcer on its posterior surface.

Cases presenting the clinical picture of a severe cystitis complicated by pyelonephritis. The best treatment to be employed here is cystotomy for drainage. Cystotomy acts as a safety-valve, puts the bladder at rest, and controls any further kidney infection. Urinary antiseptics, ammonium chloride, urotropin and sulphanilamide in large doses are of extreme value here.

If the inlying urethral catheter is not tolerated, suprapubic drainage⁴⁷ should be resorted to early. In some cases, if the pyelonephritis is severe and can be localized as involving only one kidney, or when there is a complicating perinephritic abscess, no time should be lost in exposing the kidney, being guided by the principles to be described later (Chapter 39).

In the preceding paragraphs we have attempted to outline the treatment of the cases which are most commonly first seen in the emergency stage. We will next take up the cases in which such urgent symptoms are absent.

TREATMENT OF CASES OF ELECTION

These constitute the vast majority of cases. The minor degrees of median bar, bladder neck contractures and small lateral lobe hypertrophy not producing retention, but producing some obstructive symptoms and pain, will frequently respond to prostatic massage and dilatation, with sounds, carried out at intervals. These patients are comfortable, and usually require nothing else over a long period of time. Many of these patients are now treated satisfactorily by transurethral resection. However, a number will improve with dilatation alone. Many of the symptoms in the cases of minor degrees of hypertrophy are due to the associated prostatitis which is frequently present. This can usually be relieved by prostatic massage and heat to the perineum.

No hard and fast rule can be laid down which will govern every case. There are a number of conditions which influence the decision as to whether the patient should be kept under observation, or be taught to catheterize himself, if there is retention, or be advised to have the bladder neck obstruction removed, such as

(a) Cases without retention (b) The presence or absence of a complicating diabetes (c) The condition of the cardiovascular apparatus (d) Cases with

⁴⁷ After the emergency symptoms, due to the acute cystitis and pyelonephritis, have subsided, the case becomes one of election (see below for treatment)

retention (residual urine) and the evidences of back pressure effects, both local and systemic mentioned under pathology and diagnosis

Let us consider these separately

(a) Treatment of Cases Without Retention.

General Measures. The mode of living should be regulated to avoid congestion of the prostate and bladder neck. If the patient's circumstances permit a climate should be sought for the winter's sojourn which will be as dry and warm as possible. Throughout the year every effort should be directed to prevent chilling of the body. The diet should exclude highly seasoned foods, carbonated waters, alcohol, and aim to include foods which will aid daily evacuation of the bowels. Exercise can be taken in moderation especially walking, golf, etc., but not horseback. As soon as the desire to urinate is experienced the act should not be postponed. This we have observed to have been the exciting cause of an acute retention on several occasions. The sexual life must also be regulated so as to avoid excessive congestion of the prostate and posterior urethra. In some cases there is an accompanying impotence and abnormal stimulation is sometimes resorted to by the patients. In order to overcome this,

Local Measures. The x-ray and radium have not succeeded in relieving the symptoms incident to the early stages of cases of bladder neck obstruction. Although some urologists believe that there was a noticeable reduction in the size of the prostate after the use of these therapeutic measures, the majority have not had this experience. If there is an accompanying cystitis, especially with pain on urination, the treatment outlined in Chapter 25 should be followed. With recurrent formation of vesical calculus, even though no evidences of retention can be found, one should routinely search for an obstruction at the bladder neck. In several of our cases in which calculi had either been repeatedly removed elsewhere by the suprapubic route or crushed (lithotripsy) there was no permanent relief until a bladder neck contracture, median bar, or hypertrophied prostate had been eliminated. Internal medication is seldom indicated unless it is necessary to alkalinize or acidify the urine temporarily in the treatment of an accompanying cystitis. In the way of local measures, we have found that the passage at intervals of a relatively large sound (28F) followed by the instillation (Fig. 111) of some mild silver preparation, suffices to relieve the frequency a little.

(b) The Presence or Absence of a Complicating Diabetes.

The presence or absence of a complicating diabetes is of importance because it increases the operative risk and the infection which may follow which is poorly tolerated. In addition, arteriosclerosis is a frequent accompaniment of diabetes.

With our present day use of insulin, these objections may be considered less important. Patients with a severe diabetes as manifested by high blood sugar content (hyperglycemia) of the blood or marked glycosuria should be given a "maintenance diet with added carbohydrate in the form of orange juice. In the most urgent cases, the intravenous use of glucose (10-20 per cent) with enough insulin to cover the urinary sugar" is advisable. When the glycosuria cannot be estimated immediately a large dose of insulin should be given at once and the blood sugar content of the blood determined as soon as possible so that one can

estimate the necessary dose of insulin for the subsequent treatment of the case. Patients with symptoms of impending or fully developed diabetic coma, should not be operated until rigorous treatment has been instituted and marked improvement follows.

Patients with diabetes of long standing who present no urgent (emergency) symptoms, should be treated actively with fairly high diets and insulin, until the blood sugar content is approximately normal and there is no sugar in the urine.

When these patients are sugar free, and this can usually be accomplished in a few days, operation is not attended with much greater risk than in the non-diabetic. If the prostate is not too large, transurethral resection is the operation of choice in these patients.

(c) Condition of Cardiovascular Apparatus

If there is marked evidence of cardiovascular disease in the form of decompensation or myocardial insufficiency or high blood pressure (above 200) it is advisable to treat the patient with rest, cardiac tonics, etc. In the past many of these patients were considered poor risks, for either suprapubic or perineal prostatectomy, and were often relegated to a catheter life. It is relatively rare now to see patients who catheterized themselves over a period of months or years. Patients with distinct urinary retention who without operation would use the catheter, should have the obstruction removed as soon as the maximum recovery is obtained. Since the advent of transurethral resection, the patient with cardiac disease who is a poor risk, the arteriosclerotic and the aged and feeble have been relieved of bladder neck obstruction by this procedure. When done rapidly and skillfully transurethral resection is usually well tolerated by these patients who are not good subjects for an open operation. Willius' observations are of the greatest interest and his statement that "team work has done much to reduce the operative mortality in bladder neck obstructions," cannot be overemphasized. Of 705 prostates who were examined by electrocardiography, cardiovascular disease was found in 293. The order of frequency of these was arteriosclerotic cardiac disease forty-three per cent, arteriosclerotic and hypertensive cardiac disease thirty-six per cent, hypertensive cardiac disease unassociated with outstanding arteriosclerotic features (17 per cent) and miscellaneous types of cardiac disease (including angina pectoris), four per cent. The arteriosclerotic and hypertensive types are found more frequently associated with prostatic hypertrophy than with any other form of obstruction.

The patient who is decompensated often develops an acute retention due to the edema at the bladder neck. A retention catheter is usually well tolerated. However, some patients cannot tolerate a catheter, and repeated catheterization only increases the edema. Cystotomy can be done very simply under local anesthesia with very little discomfort to the patient. It is interesting to note that the patient with cardiac disease can well tolerate a cystotomy done expeditiously, and also later a rapid suprapubic enucleation. Although it is true that transurethral resection has increased the scope of prostatic surgery in the patient with cardiac disease our experience has been that except when fibrillating or badly decompensated these patients do not react badly to open surgery when done with a minimum of trauma.

Treatment of Cases with a Minor Degree of Retention

In this group belong cases with frequency, nocturia 1 to 2 times, and slight difficulty in urination in which one finds a residual urine of from one to three ounces. The majority of such individuals are not conscious of their inability to completely empty the bladder. Clinical observations show that infection of residual urine can occur (by the hematogenous route), without the individual ever having been catheterized. This however, is so uncommon that as long as it is unnecessary to evacuate the bladder by catheter there is no urgent indication to remove the bladder neck obstruction by operative procedures on account of such a potential hematogenous infection. If the urine remains clear and the blood chemistry, functional tests, general condition, etc., reveal an absence of evidences of either local changes in the urinary tract or of systemic intoxication these patients should only be kept under observation. The regulation of their mode of life, diet etc., should be along the lines given under cases without retention until they present symptoms etc. of the next group.

Cases with Major Degree of Retention.

When the symptoms of frequency, nocturia, urgency and difficulty in urination are more marked and the residual is three ounces or more operative interference is indicated. In these patients there is evidence not only of local damage to urinary tract, but also systemic reaction to the long standing back pressure and the frequently associated infection. As Davis⁴⁴ expresses it tersely: "The advisability of operation is not determined by the size of the prostate etc. nor by the age of the patient but by the degree of obstruction produced." The indications for operative intervention are much broader now than in the past. The development of the transurethral approach has enlarged the field of prostatic surgery. Many patients with moderate degrees of obstruction can now be relieved by transurethral resection. Suprapubic and perineal prostatectomy were usually deferred in these patients in the past until the symptoms became more marked. Many patients with cardiovascular disturbances and those who are of advanced age and feeble can tolerate a rapid transurethral resection whereas the open operation may be too hazardous. It is relatively rare now to see patients who have been placed on a permanent catheter life, for even the poor risks can frequently be offered relief. When repeated catheterization or the retention catheter is tolerated this is carried on for a few weeks or months until the condition of the patient improves and then transurethral resection or surgical prostatectomy can be done. When the catheter is not well tolerated or the condition of the patient does not improve cystotomy should be done under local anesthesia for the purpose of drainage and for renal decompression. There is nothing as satisfactory in prostatic surgery as a preliminary suprapubic cystotomy. When the risk was considered too great for prostatectomy these patients were kept permanently on cystotomy drainage. In other cases many months or even years would elapse with a cystotomy tube in place before prostatectomy was considered safe. In a review of a large series of cases taken from the records of the Cook County Hospital (Rolnick and Riskind)⁴⁵ we noted that the safest of all operative approach on the prostate was suprapubic cystotomy followed by transurethral resection. These bad risks who have had preliminary suprapubic drainage can be relieved of their obstruction

⁴⁴ Edwin Davis, Neb. Med. Journ., 12:47 (Feb.) 1917.

⁴⁵ Rolnick and Riskind, Jour. Urol., 37, No. 1 (Jan.) 1937.

later by transurethral resection. Careful pre-operative preparation has lowered the mortality in prostatic surgery to the point where it is no greater than for other operative procedures, constant attention to many details of the pre-operative care is necessary. These include the following—most of which have been previously mentioned:

Pre-operative Preparation of Cases 1 Treatment of any cardiovascular disturbance (see above)

2 Treatment of diabetes (see above)

3 Thorough examination for any underlying or associated lesion of the central nervous system

4 Tests for coagulation time of the blood. If delayed, calcium chloride or thrombo or hemoplastin are given for a week before operation

5 Reduction of the vesical and renal infection as far as possible (see above)

6 Aiding elimination through the kidneys by large amounts of fluid with fruit juices⁵⁰ and thorough elimination through the alimentary tract

7 Complete information as to the type of obstruction, and of complicating vesical diverticula or calculi, by urethrocystoscopy, wherever possible

8 Decision not to operate until the results of the chemical examination of the blood and phthalein output are satisfactory

We will only discuss the last named a little more in detail

There is at present but little difference of opinion in regard to the value of blood chemistry as a guide in determining the time when operative procedure is safest. The same cannot be said of the dye and analogous tests such as the concentration and dilution tests, which are very valuable in Wildbolz's opinion. Although we know that there may be a retention of end products of protein metabolism in the tissues (see Chapter 8) without causing any changes in the chemical composition of the blood, yet the results of the latter can be taken as a fairly accurate guide as to nitrogen retention and hence of renal insufficiency.⁵¹ A patient whose blood urea is over 50 mg per 100 cc and creatinin over 2 mg per 100 cc is not a safe risk. Every effort must be made either by the use of the indwelling catheter or suprapubic drainage and forced fluid intake, to bring the percentage of the above to 30 and 1.5 respectively.

In regard to the phthalein test there is beginning to be some doubt about its value in determining renal insufficiency. This is due, as E. Clay Shaw and Hyman have shown, to the variation in the quantity of the dye which is eliminated during the usual two-hour period of observation. It is far safer to extend the time of observation to four hours. In some large urologic clinics the phthalein test has been practically abandoned and greater reliance placed upon the results of the chemical examination of the blood, taken in conjunction with the appearance of the patient. By the latter, we mean the recession of the symptoms of dehydration and urosepsis, previously enumerated.

If the phthalein test is employed, one may say in general, that a high urea content in the blood and a low phthalein output, are as a rule, concomitant findings. A patient with a blood urea of over 50 mg per 100 cc and a phthalein output below 30 is not a good risk.

⁵⁰ Orange juice is given preference. We rarely find it necessary to give glucose intravenously.

⁵¹ This term is almost universally employed at present to indicate the inability of the kidneys to perform one of their chief functions, viz., to eliminate waste products of metabolism.

Types of Operative Procedures. The technic of these is taken up in Chapter 49 so that only the various procedures at our disposal will be cited here.

1 **THE THOMPSON COLD PUNCH AND THE RECTOSCOPE** All of these are recognized procedures for cases of contracture of the vesical neck and for median bar formation.

2 **PERINEAL AND SUPRAPUBIC PROSTATECTOMY FOR PROSTATIC HYPERTROPHY** We do not propose to enter into the discussion of the still actively debated question of the relative merits of the two methods (perineal and suprapubic) of removal of the hypertrophied prostate. The choice between the two is largely based upon the following:

(a) **Personal experience.** The majority of operators find that the technic of suprapubic prostatectomy is much simpler than that of the perineal route.

(b) There is a feeling that injury of the external vesical sphincter (Figs. 49, 258 and 259) is much less likely to occur in suprapubic removal.

(c) Many cases require suprapubic drainage as a first step because the indwelling catheter cannot be tolerated and the removal of the prostate through such an opening is a comparatively simple procedure, under spinal or sacral block anesthesia (see Chapter 10).

(d) There still prevails the impression amongst urologists that fistula following operation is more common after perineal prostatectomy.

Choice of Operative Method. The three methods of approach for the removal of the obstructing prostate are suprapubic, perineal and transurethral. Personal experience of the operator is a large factor in the choice of the operation. Some urologists do perineal prostatectomy routinely in practically all cases. Others find two-stage suprapubic prostatectomy as the most satisfactory procedure and follow it routinely. In recent years, since the advent of transurethral resection and transurethral prostatectomy, this method of approach has been adopted routinely in practically all cases by some urologists. In some clinics this method has completely replaced both suprapubic and perineal prostatectomy. Some men who have acquired considerable skill in transurethral prostatic surgery are able to adequately remove all obstructing tissue by this method irrespective of the size of the prostate. However, the majority of urologists will have best end results by selecting the type of operation best suited for the individual case, having in mind particularly the type of obstruction present. We have not limited ourselves to one type of operation. We have had considerable experience with perineal prostatectomy and transurethral resection as well as suprapubic prostatectomy, and agree with most urologists that there are certain indications for the various types of operations.

INDICATIONS FOR TRANSURETHRAL RESECTION. Median bars and contractures at the bladder neck are ideally suited for this procedure. Small commissural hypertrophy or median lobe enlargement and minor degrees of lateral lobe hypertrophy are also well suited for transurethral approach. Carcinoma of the prostate will be discussed later in the chapter. When more than 20 grams of tissue require removal, this can be considered an indication for surgical prostatectomy. Although some urologists are of the opinion that there are no contraindications to transurethral surgery, the following conditions require a preliminary suprapubic cystotomy: Marked prostatic infection, markedly infected residual urine, a bleeding prostate with history of hematuria, inability to tolerate a retention catheter.

and high blood nitrogen retention With a cystotomy wound already present it is much easier to enucleate the prostate than to remove it transurethraly

Transurethral prostatectomy is more difficult than either perineal or suprapubic prostatectomy The resectoscope has demonstrated that the cause of symptoms in prostatic hypertrophy is due to obstruction, and that removal of the obstruction is necessary for relief Irrespective of the method of approach prostatectomy is necessary It is far easier and safer to enucleate a large prostate than to remove it by the transurethral route Those who do transurethral resection routinely remove the large prostate in stages Difficulties and complications increase in direct proportion to the amount of tissue removed transurethraly The work of Flocks in the blood supply to the prostate is illuminating "There are two groups of arteries within the prostate—an external capsular group which shows little change with age and with the occurrence of hyperplasia, and an internal group, the urethral group, which enlarges significantly with age and very markedly with hyperplasia The latter is very important in the consideration of transurethral prostatic resection and local repair following this operation for two reasons (1) Its anatomical arrangement—the urethral group of arteries penetrates at the prostatic vesical junction and then turns distally in a course more or less parallel to the urethral surface, (2) its ultimate destination—this group of arteries forms the main source of blood supply to the hypertrophied portion of the prostate" Thus, removal of tissue from the floor of the urethra and bladder neck only, i.e., "resection," is not only unsatisfactory for the relief of obstruction, other than a bar or small middle lobe, but also deprives the remaining hypertrophied tissue, if left behind, of most of its blood supply When much tissue is left behind, the urine continues cloudy for a long period of time The "muddy" urine is due to slough and secondary infection of the remaining tissue which has an inadequate blood supply

COMPLICATIONS OF TRANSURETHRAL RESECTION *Hemorrhage* This is much better controlled at present with the use of the Foley-Alcock hemostatic bag attached to the retention catheter It is still a serious complication—the patient can become exsanguinated in a few hours Late secondary hemorrhage is common, occurring within 4 to 5 days, but frequently 10 to 12 days later This can also be severe, indicating some infection Carcinoma of the prostate frequently shows later recurrent bleeding

Infection Prostatitis is practically always associated with an hypertrophy The retention catheter acts as a double edged sword, for it also promotes infection When the residual is 100 cc or less, no preliminary catheterization is done Many urologists cystoscope the patient only immediately before resection in order to avoid infection Most of the urologists who employ the cold Punch—the Thompson Resectoscope—do not give the patient any preoperative preparation or catheterization even in the presence of complete retention in order to avoid infecting the prostate and urethra by preliminary catheterization With infection there is a sudden rise in temperature, chills are frequent A marked pelvic cellulitis may ensue with ascending retroperitoneal infection Septic pneumonia with multiple abscesses is found in fatal cases

Incontinence The over-dilatation with the large calibered instrument used in resection may destroy the external sphincter, also damage may result from too much traction with the Foley-Alcock bag In doing the resection both the external and internal fibers of the sphincters may be cut

Operative Complications These are not as common as in the past. One who does resections should have a large experience with the cystoscope also, be well provided with a capable nursing and medical staff for the postoperative care. The casual operator will be much safer with a two-stage suprapubic prostatectomy.

Rupture of the Urethra As stated previously the resectoscope is a large instrument, false passages may occur a tight stricture may be torn, and the resectoscope loop may go through the prostatic capsule or the urethra. This is a serious complication and requires cystotomy and drainage as soon as it occurs.

Urinary Extravasation Rupture of the prostatic urethra and extravasation through injury to the bladder, or rupture of thin prostatic capsule will result in extravasation. The patient very early usually during the operation complains of marked suprapubic pain and within a few hours of pain on one side with tenderness and objective evidence of extravasation. Some of the other complications will be discussed in Chapter 45. Operations on the Prostate.

INDICATIONS FOR CYSTOTOMY FOR PRELIMINARY DRAINAGE These have already been mentioned. Bladder Calculi or diverticula in association with hypertrophy also require preliminary cystotomy. When in a quandary as to whether to do a resection in a border line or complicated case it is well to remember there is nothing that gives the surgeon as much a feeling of security as a preliminary cystotomy. In a review of a large series of cases from the records of the Cook County Hospital recently published by one of us the mortality from cystotomy was reported as over 20 per cent. However this included a large number of very poor operative risks for whom relief was attempted, and it also included cystotomy done for stone, diverticulum and tumor. The mortality from cystotomy preliminary to prostatectomy in private practice done carefully under local infiltration anesthesia is less than 5 per cent.

INDICATIONS FOR SUPRAPUBIC PROSTATECTOMY Some urologists do preliminary drainage with a retention catheter and then remove the prostate in one stage. Occasionally a one stage prostatectomy without preliminary drainage in a patient who is a good risk may be indicated. However the two-stage operation a preliminary cystotomy with drainage followed by prostatectomy 10 to 14 days later is the standard procedure followed by most urologists. The large intravesical prostate should be removed suprapubically. When there has been considerable infection of the prostate marked reduction in size follows suprapubic drainage. The bleeding prostate should be removed suprapubically. It is interesting to note that cystotomy alone will control active prostatic bleeding—the soft spongy prostate that bleeds readily is more safely removed suprapubically than by the trans-urethral route. The large prostate with lateral lobes extending upward subvesically is more safely removed suprapubically.

INDICATIONS FOR PERINEAL PROSTATECTOMY A large prostate in a man with a large abdomen in whom the suprapubic approach would be very difficult, small fibrous prostate with chronic prostatitis, associated prostatic calculi. When carcinoma is suspected the perineal route is best for a more radical excision of tissue can be done and a possibility of cure exists.

Complications. SYSTEMIC COMPLICATIONS 1 Cerebral hemorrhage or thrombosis. 2 Cardiac complications (angina pectoris auricular fibrillation etc.) These are less common since better team work between the internist and urologist prevails (see above). 3 Pulmonary complications (pneumonia pulmonary em

bolism septic broncho-pneumonia, etc.) Pulmonary embolism is not so frequently observed when the patient is allowed to be active at a much earlier period of his convalescence, than formerly 4 Signs of renal insufficiency may present in the form of convulsions, anuria, stupor, hiccough, vomiting, etc. These are seldom observed if the preoperative care of the kidneys has been adequate 5 Acute gastric dilatation and adynamic ileus (These are taken up more fully in Chapter 54) 6 Sepsis from the prostatic bed often terminating in septic bronchopneumonia and multiple renal cortical abscesses

EARLY LOCAL COMPLICATIONS OF SUPRAPUBIC AND PERINEAL PROSTATECTOMY

1 **HEMORRHAGE** This may occur immediately, i.e., within the first forty-eight hours or be delayed (second or third week) The former can be avoided by careful suturing of the prostatic bed and the use of the Hunt modification of the Pilcher-Hagner bag (see Chapter 49) Hemorrhage is less frequently seen after perineal prostatectomy

2 **WOUND INFECTION** This may involve the edges of the incision or spread to the perivesical and perirectal spaces Alkaline infection of the wound is frequently observed, particularly in the debilitated, and when there is marked infection of or bleeding from the prostatic bed

3 **EPIDIDYMITIS AND SEMINAL VESICULITIS** These occur in about 20 per cent of all cases They can be eliminated by prophylactic ligation and division of the vas deferens (Vasectomy) preceded by injection of the seminal vesicle (Vasotomy), through the divided proximal end of the vas, before ligation This is now our routine procedure if the patients' consent can be obtained

LATE LOCAL COMPLICATIONS 1 **PERSISTENT FISTULA** This is most commonly due to a stricture at the prostatomembranous (Fig 253) or at the prostatovesical junction If one dilates these with a bougie (conical end) or sound, the fistula will usually close rapidly Strapping of the suprapubic wound combined with the use of the inlying catheter (Fig 106) will greatly hasten its closure

2 **PERSISTENCE OF SYMPTOMS** such as frequency, retention, pyuria, etc., may be due to the presence of tags, a shelf or canopy formation (Fig 253) above the prostatic bed, overlooked diverticula or to a pyelonephritis (often with an associated reflux) (Fig 249)

Hyman has shown by postoperative cystography that an hour-glass deformity may follow prostatectomy and favor infection We found that this (Fig 270) was the cause of recurrence of symptoms⁵² in a case which we saw three years after prostatectomy, elsewhere Symptoms may persist if a neurologic lesion (see above) has been overlooked The same is true if microscopic examination of the excised tissue is not carried out routinely The presence of a carcinoma (see later in this Chapter) may be quite evident from the gross appearance of the specimen at operation or the malignancy only discovered on microscopic examination This was the case in 2 per cent of 277 supposedly benign prostates reported by Aschner⁵³ Caulk⁵⁴ reports similar findings

⁵² The wall of the prostatic bed was thickly incrustated with phosphatic deposits

⁵³ Aschner (Jour Urol 12 251, 1924)

⁵⁴ Caulk (Bost Med and Surg J 190, 700, 1924) found carcinoma in seven per cent of 150 cases of contracture and bar formation at the vesical neck

3 RECURRENCE AFTER OPERATION These are of two varieties (a) false, i.e., a nodule has been overlooked and remains attached to the surgical capsule and (b) true recurrence Cases of the latter form have been reported by Takahishi

FIG. 253

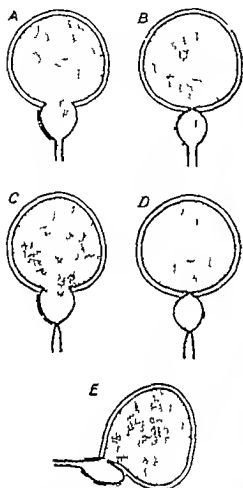


FIG. 253—Diagrammatic representation of various causes of postoperative complications at or near bladder neck after prostatectomy. (See text.)

A Hour glass deformity (See Fig. 254)

B Stricture at junction of prostatic bed and bladder (most common)

C Stricture at junction of anterior end of prostatic bed and urethra (less common)

D Stricture at both ends of prostatic bed (rare)

E Canopy of shelf over prostatic bed so that prostatic bed and bladder are almost separate

FIG. 254—Cystogram showing hour glass appearance of bladder and prostatic bed three years after suprapubic prostatectomy

FIG. 254



If a removed prostate reveals small nodules on its surface or is composed of many separate nodules (of hyperplastic glands) one can easily visualize how a nodule could be overlooked

MALIGNANCIES OF THE PROSTATE

CARCINOMA OF THE PROSTATE

PATHOLOGY

In order to understand carcinoma of the prostate one must bear in mind the following

(a) The normal prostate (Fig. 57) is made up of a large number of glan

dular acini which radiate in all directions from the lumen of the urethra in the adult (Figs 57, 63 and 238) as in embryonic life (Figs 10 and 11)

(b) The so-called hypertrophied⁵⁶ prostate is composed of a number of nodules and each of these in turn is formed by glandular acini in a state of hyperplasia or proliferation which still remains within normal range, i.e., does not present the characteristic indications of malignant changes (see below) The origin of these hyperplastic nodules from certain glands of the normal adult prostate was explained above

After middle age, the prostate may either fail to undergo the glandular hyperplasia characteristic of prostatic hypertrophy, i.e., it may (a) remain normal in its architecture or (b) certain of its glands proliferate in a typical manner to form the so-called "hypertrophied" prostate

In view of the above it is not difficult to visualize how atypical proliferation of the epithelium of the glands of either the normal or "hypertrophied" prostate will result in a carcinoma This origin of a carcinoma of the prostate from the glands of either the normal adult or the "hypertrophied" prostate explains why the type almost invariably seen is an adenocarcinoma

Cancer of the prostate develops in one of three ways

(a) In a limited portion of the adult prostate, usually the posterior portion (wrongly called lobe) or lamella

(b) Diffusely in one or both lobes of the normal prostate (Fig 57)

(c) In association with prostatic hypertrophy (Fig 255)

In this last named group one frequently first observes carcinoma in the posterior portion of the gland, but it can equally as often be seen only on naked eye or microscopic examination, in other portions This explains the frequent clinical association of benign prostatic hypertrophy (really hyperplasia) and of carcinoma It emphasizes the necessity of both naked eye and microscopic study of every removed prostate or other neck obstructions Statistics vary as to the frequency with which adenocarcinoma has been found in prostates removed at operation for apparent benign hypertrophy

Incidence Aschner found malignant changes in 2 per cent of 277, Kummell in 21 per cent of 204, Floderus in 10 per cent of 800, Young in 17 per cent of 3,236 and Swan in 25.7 per cent of 674 cases

Recent reports by Rich and Moore are of interest and are illuminating They show a high incidence of occult carcinoma of the prostate Rich reports the finding of carcinoma of the prostate in 41 of 292 autopsies Of this number 27 were not diagnosed clinically Moore noted that carcinoma begins in the posterior subcapsular portion, or the posterior lobe of the prostate and is quite independent at first of the hyperplastic lobes In Moore's 52 cases of occult carcinoma diagnosis was made in only 10 Carcinoma of the prostate occurs with increasing frequency from the 5th decade until the 9th decade, when it reaches the incidence of almost 30 per cent The finding of carcinoma following enucleation in apparently benign hypertrophy has been reported to vary between 5 and 15 per cent It is well to note that the microscopic diagnosis of carcinoma of the

⁵⁶ In the section on hypertrophied prostate we have urged retention of this term because of its being more generally employed than the more accurate one of hyperplasia or as Ribbert prefers, adenoma

prostate is often difficult in early cases, and that pathologists may frequently disagree in the diagnosis of carcinoma where there is no clinical evidence. This can account for the variations in the incidence of carcinoma of the prostate in the various reports. A review of the necropsy records of the Cook County Hospital indicates no incidence of occult carcinoma of the prostate as being over 10 per cent.

There are certain characteristics of prostatic cancer from the pathologic standpoint which it is advisable to keep in mind clinically. These are:

(a) If the epithelial proliferation predominates over that of the fibrous stroma, the growth is soft. If the opposite be the case the growth is very hard. We will direct attention again under diagnosis to the fact that the absence of the typical stony hardness in carcinoma of the prostate on rectal palpation, does not exclude malignancy.

(b) The growth is usually limited by the fascia of Denonvilliers (Fig. 48) and travels upward so as to invade the base and later all of the seminal vesicles and also the notch (interventricular) between them. In some cases the growth at first remains confined to the prostate (which is of the utmost importance from the standpoint of operability).

Extension of the growth beyond the limits of the prostatic capsule takes place in one or more of three ways:

1 By contiguity to the urethra, bladder⁵⁶ and rectum. Of these the urethra is far more frequently invaded than the other two. The bladder wall remains free until a comparatively late stage. In some the entire bladder may be surrounded by carcinomatous infiltration before the mucosa is involved. In a recent case, severe hematuria was a prominent symptom during the terminal stage as the result of such an involvement of the posterior bladder wall. Carcinoma may attain an extensive growth in the prostate and seminal vesicles without causing any urethral obstruction. In other cases, the fibrosis⁵⁷ occurring with carcinoma may constrict the vesical orifice or prostatic urethra or may give rise to obstructing bars at the vesical orifice. These facts must be kept in mind in the treatment by cautery punch or suprapubic excision of median bars or bladder neck contractures. Caulk found carcinoma in 7 per cent of 150 such cases. Ulceration of the urethral mucosa overlying the malignant prostate can occur exceptionally at a comparatively early period and give rise to a massive hemorrhage into the bladder as was observed by us in a recent case.

2 Extension to the perireteral tissues takes place late and results in compression of the ureters with resultant dilatation just as is so often the case in carcinoma of the uterus (see Chapter 35). Extension by contiguity may involve the pelvic fascia and its loose fibrous tissue and from here upwards into the retroperitoneal area and even into the mediastinum.

3 Lymph Node Involvement. For clinical purposes it is important to remember the following routes of lymphatic drainage of the prostate:

(a) LYMPHATICS WHICH PASS ALONG THE SIDES OF THE RECTUM⁵⁸ to the nodes

⁵⁶ Late extension to the bladder often gives rise to the first symptoms, or may cause such a degree of obstruction of the vesical neck as to necessitate relief by the cautery punch or cystotomy.

⁵⁷ Young, *Urology*, Vol. 2, p. 625, 1926.

⁵⁸ We have recently observed a case in which the earliest symptoms were rectal, owing to the development of an extensive involvement of these pararectal lymphatics.

along the internal iliac vein (Figs 58 and 256) These nodes are in close relation to the sacral plexus and explain the appearance of uni- or bilateral sciatica (see symptoms), as an early symptom in some cases

(b) LYMPHATICS WHICH PASS ALONG THE SEMINAL VESICLES, (Fig 256) vasa deferentia and lateral aspects of the bladder to empty into the external iliac nodes

(c) LYMPHATICS WHICH DRAIN THE NODES OF THE EXTERNAL AND INTERNAL ILIAC CHAINS and pass upwards along both sides of the large abdominal and thoracic blood vessels The invasion of this last named group explains the widespread involvement seen in some cases, at an early and in others only at a late

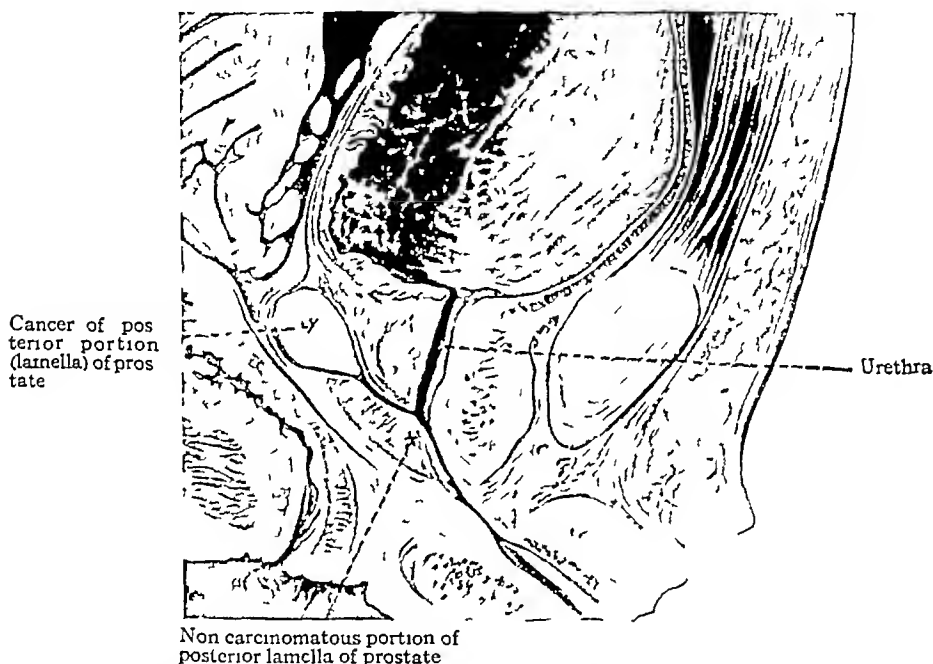


FIG 255—Sagittal section of bladder showing development of carcinoma in the posterior portion of a prostatic hypertrophy (Tandler and Zuckerkindl)

stage, of the retroperitoneal tissues At times even the mediastinum is invaded by an extension of this carcinomatous lymphangitis and lymphadenitis The potential involvement of the lymph nodes such as the supraclavicular and deep cervical, can be easily visualized from what has just been stated Bumpus found such an enlargement (supraclavicular) in twenty-five (11 per cent) of 243 cases in which the spread along the lymphatics was demonstrated

(d) LYMPHATICS TO THE FEMORAL AND INGUINAL NODES This mode of extension of a carcinoma of the prostate is comparatively rare, yet we recall a recent case in which an old man was admitted to the hospital on account of an inguinal adenitis which was found on further study to be secondary to a carcinoma of the prostate Bumpus found the inguinal nodes involved in forty-four cases (18 per cent of lymphatic system metastases)

Metastases by the hematogenous route Why primary carcinomata of certain organs like the prostate, breast and thyroid should be more frequently followed by secondary deposits in the bones, is still an unsolved question That this is true of prostatic carcinoma is to be constantly borne in mind clinically The symptoms due to such metastases may precede those referable to the prostate

itself. In the case whose lumbar spine and pelvis is shown in Figure 188 the chief complaint was backache. The frequency of urination was considered by the patient as being of minor importance.

The most common site of involvement is the sacrum and adjacent portions of the spine and pelvis. Later metastases involve the ribs and femurs. Bumpus found that of 539 patients who were examined roentgenographically, the pelvis was found involved in 123 (20 per cent) and the spine in 107 (almost 20 per cent).

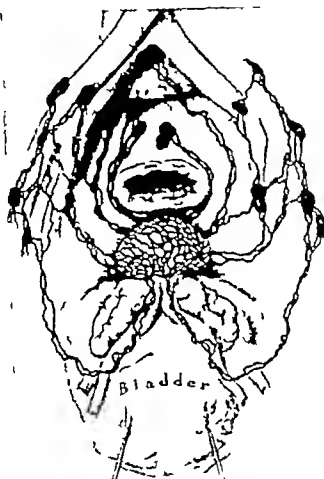


FIG. 256—Lymphatics of prostate. (Courtesy of Dr. R. H. Herbst.) Note channels formed by lymphatics of prostate on its surface. From these four main trunks drain into lymph nodes about iliac vessels, hollow and promontory of sacrum.

The femur was affected in sixteen and the ribs in ten. We shall refer under Diagnosis to the necessity of routine roentgenograms of the above possible localizations in all cases of prostatic carcinoma.

Although the majority of those who have studied the subject of osseous metastases are of the opinion that the latter reveal evidences of a hyperostosis, or osteo-blastic metastases which show an increase in calcium deposit thus giving an increased density to the bone. Our own experience is that an osteoporosis or osteo-clastic metastases causing bone destruction often involving many bones (Fig. 171) apparently simultaneously i.e., a diffuse osseous carcinomatosis is not uncommon. Metastases to the lungs liver kidneys and spinal cord have all been observed in advanced cases. It is of interest to note that in several of the cases of metastasis to the spinal cord reported from the Mayo Clinic by Bumpus, there were no urinary symptoms. The root pain (due to pressure on the spinal

nerves) and the paralysis were the initial and sole complaints. The malignant disease of the prostate was discovered during the general physical examination.

Types of Carcinoma "Hammond classifies carcinoma of the prostate clinically into 3 types, (1) the acute inflammatory type, with a rapid spread to the surrounding tissues, and death within a few months. Here there is no local resistance to cancer, (2) disseminating type, where, though the primary growth is small, metastases are present almost from the start. Here there is no general resistance to cancer. This type of dissemination is more commonly seen in carcinoma, beginning in encapsulated organs, such as the kidney, thyroid, and prostate, than in other structures. However, both the inflammatory and disseminating types are infrequent. (3) The great majority of cases are classified as the scirrhus type. This practically covers all the cases seen clinically. In cancer of the prostate the growth remains localized for a long period, and dissemination to the glands, bone and viscera occur later. Cancer of the prostate in some cases grows very slowly, may give rise to little or no inconvenience, and the patients may live in comfort for many years, often dying of some inter-current disease. If the growth does not ulcerate into the bladder, the patient dies slowly of uremia, due to extension of the carcinoma to the ureters with ensuing ureteral obstruction. Although the above statement is correct in certain instances, most patients live 24 to 30 months, weakness is marked, there is considerable perineal and sciatic pain, back ache is marked, pain due to metastases is common, and urinary symptoms are often severe."

SYMPTOMS AND CLINICAL PICTURES OF CARCINOMA OF PROSTATE

Cases of prostatic cancer are usually seen under one of the following clinical pictures

(a) Frequency, difficulty of urination and retention resembling in every respect the picture of a benign bladder neck obstruction⁵⁰

(b) Onset of symptoms such as pain in the back, along one or both sciatic nerves, etc

These are the two clinical pictures which the majority of cases present. In a much smaller number, the first symptoms or complaints are

(c) Hematuria. This is seldom of gross (naked eye) character at the onset. In one of our own cases,⁵⁰ however, a massive hemorrhage into the bladder, distending it to the umbilicus (Fig 190) was the initial symptom. In 137 of 1,000 cases reported from the Mayo Clinic by Bumpus,⁵¹ gross hematuria was noted at some period of the disease.

(d) Rectal symptoms. These may be initial in advanced cases which have pursued a symptomless course up to the time when the rectum is involved, either as the result by direct extension of the growth itself or by lymphatic metastases. In a recent case, the initial symptoms were those characteristic of thrombosed hemorrhoids. A large perirectal mass could be palpated easily. Of the above modes of onset, the first two deserve special consideration.

The clinical pictures in which there are only complaints such as frequency,

⁵⁰ See earlier portion of this chapter

⁵⁰ This case was referred to under Emergency Cases of Acute Retention (under prostatic hypertrophy)

⁵¹ S. G. and O., 43, 150, 1926

pain on urination, difficulty in voiding and even attacks of acute or persistent chronic retention do not differ in any respect from those described as characteristic of benign prostatic hypertrophy. It is only through routine palpation of the rectal side of the prostate and vesicles in every case presenting the above symptoms, that a possible malignant change in a case of bladder neck obstruction can be recognized early (see Diagnosis).

In the second most frequent variety of clinical pictures, there is often an absence of any symptoms referable to the urinary tract. Many such cases consult the physician on account of backache (lumbosacral) or pain radiating downwards along the course of the sciatic nerves. Keyes has called attention on this account to the fact that a bilateral sciatica in old men is pathognomonic of prostatic cancer.⁷⁷

We have stated above, that about 25 per cent of the bony metastases are located in the lumbar spine and the bones of the pelvis. For this reason routine x-ray study of these bones combined with rectal examination is indispensable in every case presenting the above symptoms, in men above middle age.

In rare cases, the first symptoms presented are those of metastases in distant parts of the body e.g., a bone tumor or a fracture which has occurred after a slight trauma. One should therefore always bear in mind in elderly men the possibility of such an apparently spontaneous fracture or obscure bone tumor being secondary to a prostatic malignancy.

DIAGNOSIS⁶²

We have just seen that there is nothing characteristic about any of the clinical pictures under which prostatic cancer presents. This is especially true of those cases in which it is associated with a hypertrophy of the gland. Under pathology attention was directed to two types of prostatic cancer, viz. (a) those in which it develops in a gland which is the seat of a hypertrophy (really hyperplasia) and (b) in a prostate which does not present such changes. We also stated that carcinoma may remain confined within the gland capsule or it may penetrate it and spread in all directions especially upwards in the direction of the seminal vesicles because of the resistance offered on the rectal side by the fascia (Fig. 247) of Denonvilliers.

Finally we pointed out that the malignant changes in a prostate are not always accompanied by induration but that there are forms which are more cellular and hence much softer. In one case which we examined recently the prostate itself was of normal soft consistency but at one lateral edge it was only separated by a slight depressio from a perirectal and presacral very hard metastasis the size of an adult fist.

Site. Carcinoma most commonly develops in the posterior portion (lamella) of a benign or hypertrophied prostate (Fig. 255). The latter may obscure the presence of a cancer.

(a) If the cancer is primary elsewhere than in the posterior lamella and is surrounded by spheroids (nodules) of benign hypertrophy.

(b) If the carcinoma develops in a thin layer in this posterior lamella (Fig.

⁶² We wish to express our appreciation of the excellent chapter in Young's Urology in the preparation of this section.

271), it may not be palpable owing to the elasticity of the hypertrophied prostatic tissue behind (posterior) to it

(c) If the growth only forms a hard nodule in the posterior lamella, it may have a sense of elasticity imparted to it by the hypertrophied prostatic tissue behind it

In the typical case⁶³ of prostatic carcinoma one or both lobes feel "stony hard" and are fixed ("frozen")

One should always palpate

(a) Above (proximal) the base of the prostate (Fig 44) to ascertain whether there is induration of the notch (intervesicular) between the seminal vesicles as well as involvement of the base or greater portion of the latter

(b) In a distal direction beyond the apex of the prostate in order to determine whether the membranous urethra is involved. When this occurs, the urethra (just beneath pubic arch) feels broader, hard and fixed

Often both of the above as well as palpation of the groove between the two lobes of the prostate are facilitated by inserting a cystoscope or a metal catheter (as in Fig 72) and after turning the beak backwards, to palpate the intervening structure. Young (*loc cit*) emphasizes that on rectal examination one should note

(a) Extensive induration with adhesions and fixation, especially if this involves the seminal vesicles, no matter whether there is stony hardness present or not

(b) Nodules which are much firmer than the adjacent tissue

(c) Broadened, thickened and fixed membranous urethra and same condition of the intervesicular notch

(d) Thickening and induration of the lymphatics and lymph glands (nodes) around upper end of the seminal vesicle and on the lateral wall of the pelvis

(e) Combined digital and cystoscopic (or metal catheter) palpation of the urethra and prostate

The presence of any or all of the other types of bladder neck obstruction (see above) does not exclude the concomitant existence of a carcinoma

Cystoscopy is of little value in early cases, however, it is of considerable value in the diagnosis of more advanced cases. Fixation and rigidity of the bladder neck are of great diagnostic import. It may show some edema and elevation of the trigone but nothing pathognomonic of malignancy in the prostate. At times the latter may invade the bladder so that it is impossible to tell whether the bladder or prostatic neoplasm was primary

Aspiration biopsy of the prostate has proved to be of extreme value in the diagnosis of carcinoma. Reports from the Memorial Hospital by Ferguson show that a diagnosis can be made in 85 per cent of the cases, and that very few prostates which give a negative biopsy finding show occult carcinoma on enucleation. The aspiration biopsy is more accurate than the examining finger. There are many difficulties to be considered in aspiration biopsy, but it is a definite advance in the diagnosis of carcinoma of the prostate. Some cases of carcinoma otherwise undiagnosed may be discovered early enough to make possible a cure of the patient by simple enucleation or radical perineal prostatectomy

⁶³ Attention has already been called to the exceptional cases in which soft, even semi-fluctuant, enlargements of the prostatic lobes are felt on rectal examination

In some instances carcinoma of the prostate is not diagnosed and the patient dies of his metastases with a finding of prostatic carcinoma only on post mortem ⁶⁴ Occasionally even the pathologist may have difficulty in locating the primary nodule that has been the source of the metastases.

DIFFERENTIAL DIAGNOSIS

Chronic prostatitis. The induration is more diffuse and not of the "stone like" character as in malignancy. There is also an absence of fixation (frozen condition) which is so often palpable in cancer of the prostate. On massage one will obtain a fluid containing many pus cells and organisms. If the cancer develops, however, in the center of a prostate which has been the seat of chronic inflammatory changes, palpation is of no value.

Prostatic calculi. Here one may feel isolated nodules of a diffuse or stone like consistency. One must chiefly depend on radiography, which will reveal shadows due to the calculi.

Tuberculosis of the prostate. Here there are also isolated nodules or more diffuse induration. The latter, however, is never as marked as in malignancy and there is an absence of as much fixation (frozen condition). In addition primary prostatic tuberculosis is very rare. One can as a rule, find primary foci in the epididymis or kidney.

"Woody" phlegmon of the prostate. Thevenot (*Jour d'Urol* 17, 417 [May] 1924) reported a case of a man of eighty upon whom a prostatectomy had been performed for benign hypertrophy seven years before. He had returned on account of an acute retention. A stony hardness was felt rectally but biopsy only revealed chronic benign changes of an inflammatory nature. The same findings were noted one year later. In the discussion of Thevenot's case several similar non-operated cases were reported by Marion. Leguen was of the opinion that an infection was present resembling the "woody" phlegmon first described by Reclus as occurring in the neck. Such an infection can occur with or independent of a prostatic hypertrophy and greatly resemble the rectal findings.

We have cited these cases in the differential diagnosis of prostatic cancer because of a personal experience in which a mistake in diagnosis was made in a case of this kind in a man of seventy.

Paget's Disease Osteitis fibrosa. It is often difficult to differentiate the roentgenographic findings of this disease from those of metastases due to carcinoma of the prostate. In some cases increased density and thickness of the cranium will help to make the diagnosis of Paget's Disease.

TREATMENT

This may be considered under three headings. (a) Palliative measures alone, such as suprapubic cystotomy or transurethral resection for relief of obstruction. (b) The use of radium and x ray. (c) Prostatectomy. The only hope for cure in carcinoma of the prostate rests with the diagnosis of the early case before it has invaded the capsule and extended to the seminal vesicles. Unfor-

⁶⁴ The main reliance as previously stated in the diagnosis of carcinoma of the prostate is to be placed on rectal palpation combined with radiography of the spine, pelvis, etc. (See above.)

tunately only a very small percentage can be diagnosed early enough, for in the vast majority of the cases carcinoma of the prostate has already extended upward and is inoperable by the time a diagnosis can be made. When enucleation is done for apparently benign hypertrophy, and carcinoma is found later as a small nodule on biopsy the patient is frequently cured of his carcinoma because it has been removed very early. If carcinoma is suspected a trocar biopsy should be done. The patient should have perineal exposure of the prostate in a suspicious case, and a biopsy of a frozen section made at the time. If carcinoma is found extensive resection of the prostate and its capsule can be done in the early case with the hope of a cure. We have done Young's radical perineal prostatectomy on 26 patients. Although it is an extensive procedure the patients tolerate it well. One of our patients is living 2 years following operation apparently without metastases.

Palliative Measures The generally accepted opinion at the present time is that treatment for carcinoma of the prostate can be only palliative. The only surgery advised is for the relief of obstruction, if and when it develops. Permanent suprapubic cystotomy,⁶⁵ which, until the last few years, had been the method of choice for relief of obstruction of the bladder neck in carcinoma, has, in this country, been practically entirely replaced by transurethral resection. As the result of years of experience and trial with various methods of treatment, the generally accepted conclusion has been that by the time carcinoma of the prostate is diagnosed clinically it is already too late to operate or do anything else other than symptomatic care.

Radium has been used extensively for the treatment of carcinoma of the prostate. Various methods of suprapubic and perineal implantation, emanation and bomb have been employed. In order to be of value, the dosage must be intensive and completely destructive. This cannot be done without producing marked sloughing of the surrounding tissues, particularly the rectum. Various statistics, covering large series of cases, particularly those of Bumpus, have shown that radium is of no value, that it usually hastens the course of the disease, and leads to marked aggravation of symptoms.

X-ray therapy is only of slight value. It does not relieve the obstructive symptoms, but often relieves temporarily the backache and pains due to metastatic involvement. Rarely, as in one case reported by Smith, it reduced the size of the prostate markedly, so that it could be later removed successfully by means of a radical perineal prostatectomy. However, the symptoms are usually aggravated by treatment, which often does more harm than good.

Prostatectomy Suprapubic prostatectomy, which, can, as a rule, be only incomplete, merely aggravates the symptoms, helps very little in relieving the obstruction, and should not be attempted if cancer is diagnosed. Simple perineal prostatectomy is also incomplete, although it may be of value in relieving obstruction. Both suprapubic and perineal prostatectomy hasten the spread of the carcinoma, and usually aggravate the symptoms. Transurethral resection, which has now replaced permanent cystotomy, relieves the obstruction, but it also hastens the spread of the carcinoma, and undoubtedly aggravates the other symptoms due to extension or metastases. While resection establishes a groove, it hastens the spread of the growth by cutting through the capsule, and thus its

⁶⁵ See Chapter 52

value can also be seriously questioned. The patient can be resected a number of times whenever obstruction recurs. So to quote Charles Mayo. It is quite evident that whatever you do for carcinoma of the prostate is bound to be wrong.

SARCOMA AND OTHER RETROVESICAL NEOPLASMS

Frequency Age etc. Although nearly a hundred cases of sarcoma of the prostate have been reported, Young (loc. cit.) believes that they are rare and that the majority of cases have in reality, had their origin in the retrovesical connective tissue (see Pathology). Amongst prostatic neoplasms observed by Young only two noncarcinomatous began in the prostate. All of the others were of retrovesical origin.

In the seventy-six cases of prostatic sarcoma collected by Parmenter and Culver⁸⁰ the age varied from eight months to seventy seven years. Nearly one third (24) were below the age of ten years and thirty four (44 per cent) were between ten and twenty years old.

Pathology. Sarcoma of the prostate may involve one or both lobes. As a rule the tumor attains a much larger size than in carcinoma. The majority belong to the small round-celled variety of sarcoma. Next in order is the spindle cell type and far less common myxo-rhabdo-angio and lymphosarcomata. Tumors of mesothelial origin may also arise in the retrovesical tissue and surround the prostate so that at a late stage their origin cannot be determined. The rate of growth and mode of development of both the true prostatic sarcomata and those of retrovesical origin is quite similar. They grow very rapidly, varying in size up to that of a child's head. The bladder is pushed forward or its wall diffusely invaded. The rectum is displaced backward and in the case of the growths of retrovesical origin the prostate pushed downwards. A large mass fills the entire pelvis invading the seminal vesicles, ureters etc. In its development there is a greater tendency toward urethral involvement than in cases of carcinoma. Metastases are uncommon but are found at times in the liver, spleen, lymph nodes and bone marrow.

Symptoms and Diagnosis. The principal clinical pictures are those due to compression of the urethra and rectum. In children and young adults the initial symptom is often acute retention of urine. In some the clinical picture is quite analogous to that described under bladder neck obstruction, viz. dysuria and chronic retention. In a relatively smaller number of individuals there are symptoms referable to the rectum. Hematuria and pain are rarely observed.

On rectal examination a smooth mass can be felt replacing the prostate and extending upwards along the base of the bladder enveloping the seminal vesicles. The consistency varies from soft to hard but the latter is never as marked as in carcinoma. At times the mass can be felt above the pubes.

Treatment. This is even less encouraging than in carcinoma. In the majority only palliative measures such as cystotomy can be employed.

⁸⁰ Culver (J. Urol. 14: 47, 1925) added seventeen including one of his own to those (59) collected by Parmenter. Kretschmer who recently reported two cases (J. Urol. 16: 301, 1926) is of the opinion that the total number is well over 80.

CHAPTER 19

THE SEMINAL VESICLES

ANATOMY, ANOMALIES, INJURIES, CALCULI AND
TUMORS
INFECTIONS
TUBERCULOSIS
PUS TUBES IN THE MALE (BELFIELD)

MODE OF INFECTION
PATHOLOGY
SYMPTOMS
DIAGNOSIS
TREATMENT

The ampulla of the vas deferens and the ejaculatory duct are practically always involved in diseased conditions of the seminal vesicle, so we will discuss them in this chapter

ANATOMY, ANOMALIES, INJURIES, CALCULI AND TUMORS

The anatomic variations of seminal vesicles as classified by Picker from studies of post-mortem specimens, while of interest, are of little clinical importance. The anatomy of the seminal vesicles was not understood until radiography of these structures had been done on the living.



FIG 257—(See also Fig 50) Radiography of the seminal duct in the living showing how the ampulla enters neck of seminal vesicle at an oblique angle just as ureter enters bladder. Note how the ejaculatory duct is continuous with the seminal vesicle and not with the ampulla. The round central shadow is simply an overflow of the iodized oil into the bladder.

The ampulla of the vas deferens enters the neck of the seminal vesicle at an oblique angle (Fig 257) as does the ureter into the bladder. It does not unite with the seminal vesicle to form the ejaculatory duct, the latter structure being a direct continuation of the seminal vesicle.

The analogy of the seminal tract to the urinary tract may again be mentioned. The seminal vesicle compares with the urinary bladder, the ejaculatory duct with the posterior urethra above the verumontanum, the vas deferens with the ureter, the tail of the epididymis with the pelvis of the kidney and the body of the epididymis with the kidney parenchyma (Fig. 258).

Anomalies and Malformations. These occur quite frequently. The seminal vesicles may be absent (Fig. 259) or rudimentary. One vesicle may be larger



FIG. 258.—Entire seminal duct, from tail of epididymis to prostatic urethra, injected with iodized oil through vasotomy incision. Not even a watery fluid can be forced beyond the tail of epididymis. Large loop in pelvic vas. Large shadow of surplus oil in bladder above vesicles.

than the other. There may be various channels of anastomosis between the vesicle and ampulla. Diverticula of the vesicle may be found. The two ampullae may unite before entering the seminal vesicle. Diverticula of the ampulla are not uncommon.

The two ejaculatory ducts may unite and have a common opening in the posterior urethra. The ejaculatory ducts may open on the lips of the utricle, this being so common as to be considered within normal, or they may open within the utricle. Abnormalities of the utricle are usually associated with gross abnormalities of the genitalia as in pseudo-hermaphroditism. The ureter may open into the seminal vesicle or ampulla. It may have a common opening with the ejaculatory duct.

Injuries of the Seminal Vesicles Injuries due to external wounds are rare, the vesicles suffering only in extensive injuries to the pelvis. Objects penetrating the rectal wall in accidental injuries, may also injure the vesicles. They may be injured in operations on the bladder neck and torn in both suprapubic and perineal prostatectomy. The ejaculatory ducts are also often torn in both suprapubic and perineal prostatectomy.

Calculi and Concretions Small calculi are often found in the seminal vesicles of old men, large calculi which can be diagnosed radiographically are



FIG 259—Radiograph of necropsy specimen made by injection of 50 per cent sodium iodide through both ejaculatory ducts showing complete absence of both seminal vesicles. The entire seminal duct is seen to be injected but not beyond the tail of the epididymis.

rare. The small concretions or deposits of lime in the vesicles may cause some pain in passing through the ejaculatory duct. Incrustation of the mucosa of the vesicle and deposits of lime may occur in persistent infections.

We have seen one case in which lime was constantly present upon massage or at the end of urination. This condition does not respond to massage and is relieved only temporarily by vasotomy.

Tumors of the Seminal Vesicles Primary carcinoma of the seminal vesicle is rare. Sarcoma of the seminal vesicle has been reported. The seminal vesicles

are, however, involved very early in cancer¹ of the prostate. The extension of the growth upward from the prostate is not interfered with at this point.

Cancer of the bladder and rectum may extend to the seminal vesicles.

INFECTIONS OF THE SEMINAL VESICLES

TUBERCULOSIS

There is still some contention as to whether tuberculosis of the genitalia begins primarily in the seminal vesicle or epididymis. Tuberculosis of the seminal vesicles not only in our opinion but in that of most other urologists, in the vast majority of cases, is secondary to tuberculosis of the epididymis. Tuberculosis may in some cases be primary in the seminal vesicles. As the result of extension



FIG. 260—Radiograph made in the living, showing the sheath of the vas injected (in an upward direction) in its scrotal portion, showing Bogros space at internal ring (left half of illustration). This radiograph also shows an anomaly in form of union of both ampullae.

from a tuberculous bladder and posterior urethra, the seminal vesicles may be secondarily involved. This subject will be discussed further in Chapter 20 under Tuberculosis of the Male Genitalia.

Pus Tubes in the Male (Belfield) The work of Belfield on infections of the seminal vesicles, stands out pre-eminently in the advancement of our knowledge in this field and we shall have frequent occasion to refer to it in this chapter.

MODE OF INFECTION

The vesicles are infected as the result of extension from the posterior urethra through the ejaculatory duct or as the result of extension from the epididymis through the vas deferens. Direct hematogenous infection may occur but is rare.

From Prostate and Rectum. Infections of the prostate nearly always

extend to the seminal vesicle. Infection about the rectum and the pelvis may by direct extension or by way of the lymphatics, involve the vesicles.

Extension from the posterior urethra by way of the ejaculatory ducts is the most frequent source of infection. Gonorrhea is the most common etiologic factor. Infections of the posterior urethra secondary to a chronic cystitis is also a frequent cause of vesiculitis. In prostatic hypertrophy the seminal vesicles are often infected² from the distorted engorged posterior urethra. Contractures at the bladder neck and strictures of the urethra are often factors in producing a sub-acute or chronic vesiculitis as the result of interference with the emptying of the seminal vesicles.

Extension of infection from the epididymis is more common than is generally thought. Bacteria can be excreted by the epididymis with little or no damage to its structure, and be passed along the vas deferens to lodge in the seminal vesicles. Bacteriuria, often attributed to the prostate, usually comes from this source. All varieties of bacteria, typhoid, colon, pneumococcus, and parasites such as amebae, have been found in the seminal vesicles.

The most common organisms found in acute and chronic infections are the gonococci and staphylococci, colon bacilli and streptococci, which latter are either secondary invaders or are present primarily as a mixed infection in gonorrhea.

Predisposing and Associated Conditions

Sexual excess, coitus interruptus, continued use of condoms and ungratified sexual excitement, all of which produce either an acute or chronic congestion of the prostate and vesicles, act as predisposing factors. The man who develops an acute gonorrhea in the presence of acute or chronic congestion of the prostate and vesicles will very likely develop an acute vesiculitis during the course of the infection.

The frequent association of seminal vesiculitis and prostatic hypertrophy and also of seminal vesiculitis as the result of trauma and secondary infection in prostatectomy, is recognized by nearly all urologists. Vasectomy is a routine procedure to prevent epididymitis, which occurs in fifteen to twenty per cent of all prostatectomies, if this operation is not done. The epididymitis is the result of extension from the infected seminal vesicle. Many of the untoward symptoms following prostatectomy are due to persistence of infection in the vesicles.

The common association of vesiculitis with stricture of the bulbomembranous urethra is manifested by the not infrequent epididymitis after instrumentation.

The epididymitis is due to extension along the lumen of the vas from the already infected seminal vesicle.

The majority of infections of the seminal vesicles are associated with infection of the prostate, so that prostatovesiculitis is the condition usually encountered. Many physicians and some urologists, however, still persist in ignoring the seminal vesicles and speak merely of prostatitis when prostatovesiculitis is the condition existing.

PATHOLOGY

General Considerations The ampulla of the vas deferens although anatomically distinct from the seminal vesicle (Figs 50 and 257) is always involved in

² See Chapter 18

infections of these structures. The ejaculatory duct, the outlet duct of the vesicles, also shares in the inflammatory process. Pathologic changes of the verumontanum are usually associated with seminal vesiculitis and indicate pathology in these latter structures. The veru therefore can be aptly termed the mirror of the seminal vesicles. The associated prostatitis which is usually present results as stated before in a prostatovesiculitis, acute or chronic.

Site and Extension. The inflammation usually involves the entire wall of the vesicle and extends to the sheath and perivesicular tissues, resulting in a perivesiculitis. With severe involvement the infection may extend to the entire pelvis producing a pelvic cellulitis and in some cases a pelvic abscess.

The infection may extend from the vesicle by way of the vas deferens, either through its lumen or along its sheath. When extending through its lumen, epididymitis results. In some cases strictures of the vas deferens are due to extension of the infection for only a short distance along its lumen, the infection not reaching the epididymis.

Extension of the infection along the sheath of the vas results usually in a funiculitis at the inguinal ring. Pelvic abscess may extend along the sheath and open at the inguinal ring. Bogros space (Fig. 360) at the internal inguinal ring is loose areolar tissue in which the sheath of the pelvic vas ends. This space separates the sheath of the pelvic from that of the scrotal vas at the internal inguinal ring. Thus the extension of infection along the sheath beyond Bogros space is prevented. In some cases infection may extend the entire length of the vas along its sheath from the seminal vesicles to the tunica vaginalis and may produce an acute or chronic periorchitis. A chronic hydrocele² may be the end result.

In acute seminal vesiculitis there is often an associated congestion and edema of the prostate, urethra and bladder neck. This may cause considerable pain and difficulty on urination and in some cases partial or complete urinary retention. In chronic vesiculitis there is usually some degree of inflammation of the verumontanum and posterior urethra.

The ureter, seminal vesicle and vas deferens are in intimate relation in what has been described by Belfield as the broad ligament in the male. In acute seminal vesiculitis the distended seminal vesicle and the edematous infiltrated perivesicular tissues may obstruct the ureter³ partially or even completely. Adhesions may result from chronic vesiculitis and perivesiculitis producing in some cases stricture of the ureter⁴ and as a result, dilatation of the ureter above. Chronic adhesions may produce ureteral colic. Cystitis is not an uncommon complication of acute or chronic vesiculitis.

The seminal vesicles are the foci for infection in gonorrheal rheumatism.



FIG. 261
— Urine passed after massage of vesicles, with addition of nitric acid. a acid b white coagulum of globulins c clear urine where acid is strong, shading into d white cloud of proteina where acid is dilute. The same picture less pronounced, some times appears without massage of vesicles, especially in the last urine passed.

See Etiology of Hydrocele in Chapter 21.

See Chapter 31—under causes of ureteral colic.

See Chapter 30 on Ureteral Stricture.

and in other metastatic infections such as conjunctivitis and iritis. This has already been mentioned in Chapter 11. Some anatomical considerations may well be mentioned here.

The ampulla of the vas deferens normally has numerous dilatations appearing as small diverticula and its interior presents a pitted appearance resembling a pea pod. The seminal vesicle with its various folds and tortuous arrangement, similar to that of a pea pod, presents on cross section, the appearance of a multilocular cyst (Fig. 50). Its wall is made up of smooth muscle and it has one or two layers of secreting columnar epithelium as has also the ampulla. The ejaculatory duct, its wall made up of elastic fibers, bends downward and forward and has a mucous lining. The seminal vesicle has no glandular structures in its mucosa or submucosa.

Persistence of Infection Due to its tortuosity and sacculation, infection may persist for a long time. Poor drainage from the ejaculatory duct promotes the harboring of infection. The lack of glandular structures and poor vascularity gives the vesicle very little resistance to bacteria. Its entire lumen together with that of the ampulla can, however, be well medicated, there being no glandular structures as in the urethra, that may harbor the infection.

The associated prostatitis in either acute or chronic vesiculitis, adds to the pathology and symptoms and as stated previously, makes the infection a prostatic vesiculitis.

Pathology of Acute Seminal Vesiculitis This presents the typical picture of an acute catarrhal or suppurative inflammation, varying in degree from that of edema and congestion of the mucosa to that of diffuse involvement of the entire wall and the loose tissues about it, together with its sheath.

The vesicles are usually considerably dilated and distended with their contents of mucus, pus and occasionally blood. In mild inflammation, the mucosa is only slightly damaged but in severe involvement the epithelium is destroyed and desquamates. In the average case, the entire wall of the vesicle is involved and is considerably thickened. There is a marked perivesiculitis in the more severe infections. The ampulla shares with the vesicle in the inflammatory process. The ejaculatory duct is edematous and there may be plugs of mucus or pus partially or completely occluding its lumen. The verumontanum and posterior urethra are engorged and inflamed.

Pathology of Chronic Seminal Vesiculitis The lesions of chronic seminal vesiculitis may be (a) either the continuation of an acute attack or (b) the infection may have been subacute at the onset, gradually becoming chronic. A round cell infiltration of the mucosa and muscularis develops, and later, the formation of connective tissue. In some cases, the inflammation is limited to the mucosa and submucosa. In most cases, the inflammatory process spreads, involving the entire thickness of the wall of the vesicle, ampulla and the sheath, the degree of involvement varying with the severity of the infection.

In the milder degrees of infection, the mucosa is only slightly damaged and the thin-walled vesicle contains a large amount of mucus.

In the more severe degrees of involvement, the vesicle is thickened, there is considerable fibrosis about it and around the ampulla, the epithelial lining is either scarred or altered and the capacity of the vesicle is reduced. The various saccula-

tions of the vesicles (Fig 50) may become walled off, due to the scar formation within, producing blind sacs which contain pus.

Infiltration, fibrosis and distortion of the ejaculatory duct occurs with narrowing of its lumen. The distortion of the ejaculatory duct interferes with drainage from the infected vesicle. In rare cases the duct may become completely occluded. The ampulla of the vas may be involved partly or in its entire length and there is often considerable thickening in the space between the ampulla and vesicle thus obliterating it. The perivesicular inflammation may produce considerable chronic congestion at the bladder neck and thickening at this point. Infection from the vesicle may result in perirectal or ischiorectal abscess. The seminal vesicle may perforate and its contents escape into the pelvis.

SYMPTOMS

ACUTE SEMINAL VESICULITIS

Similarity to Prostatitis. Before taking up the symptoms of seminal vesiculitis we wish to emphasize the fact that the symptoms of the associated prostatitis are quite similar to those of vesiculitis. The symptoms of acute seminal vesiculitis vary from those of very mild to very severe type. Many of the mild or subacute infections remain undiagnosed during the acute stage their symptoms merging with those of the associated posterior urethritis. These infections, however, may become chronic.

The acute symptoms of an active infection are often overlooked because all of the symptoms are attributed to the associated prostatitis. When a large follicular or paraneurymatous prostate is felt per rectum the inflamed and indurated vesicles may be difficult to distinguish in the inflammatory mass. The infection in the prostate subsides fairly rapidly as noted later on palpation but the vesicles continue to harbor the infection for a considerably longer period.

The hyperacute form of seminal vesiculitis presents marked local and systemic reaction. The symptoms are those of an acute pelvic cellulitis. This hyperacute type is not seen often. The prostate is usually involved in infections of the vesicles as is also the prostatic urethra, so that it is often difficult to distinguish to what degree the symptoms are due to the vesiculitis. Certain symptoms are characteristic of vesiculitis and others may be present with any form of bladder neck involvement. This has been discussed fully in Chapter 11 under the Complications of Gonorrhea. The symptoms of acute seminal vesiculitis due to other infections, do not differ from those due to gonorrhea.

Frequent somewhat painful nocturnal emissions with blood or pus in the semen is diagnostic of seminal vesicle involvement. The urinary symptoms that may be present are not particularly characteristic of seminal vesiculitis and may occur with any acute bladder neck involvement. They are pain, urgency, frequency, tenesmus and nocturia as follows:

- 1 **Perineal Pain.** A dull ache or pain in the perineum with pain or tenderness in the gluteals are frequent symptoms. The pain is often referred to the thighs, scrotum and testicle. There are evidences of congestions in the perineum due to prostatovesiculitis.

- 2 **Backache** is often present although this symptom is more frequent in subacute and chronic vesiculitis.

3 Suprapubic and lower abdominal pain is very often present. There may be a feeling of fullness or pressure over the bladder region and the pain may be on one or both sides of the lower abdomen.

4 Pressure. There may be a feeling of pressure in the inguinal regions with pain referred here.

5 Pain and burning in the urethra, more marked upon urination is very common. This pain may be in the perineum but is also often referred to the glans penis or fossa navicularis.

6 Fever. In the hyperacute type, the fever may be marked and reach 104 or 105° F. There may be considerable lower abdominal rigidity and there is evidence of pelvic peritonitis. These cases have been mistakenly diagnosed as appendicitis.

7 Acute Urinary Retention. The acutely infected and distended seminal vesicles may produce enough congestion and edema of the posterior urethra and about the bladder neck, as to interfere with the emptying of the bladder so that acute retention may ensue. The acute urinary retention usually ascribed to a prostatic abscess in gonorrhea is in the majority of cases, due to vesiculitis. The sudden evacuation of a large quantity of pus usually ascribed to rupture of a prostatic abscess is due in most cases to the sudden emptying of the distended seminal vesicle. Immediate relief results.

8 Ureteral colic^o and pain referred to the kidney is not rare. It is due to pressure and swelling about the ureter from the distended seminal vesicles. Cases of obstructive anuria due to ureteral block from this cause have been reported.

Clinical Course

Those with only a slight degree of involvement clear up with routine treatment. Many of the cases of subacute vesiculitis, however, persist and become chronic. The more severe infections unless promptly treated develop into chronic vesiculitis.

Complications

Perivesiculitis is practically always associated with severe involvement and cannot be ranked as a complication.

Acute pelvic cellulitis. Infections of the prostate and vesicles may spread to the surrounding tissues, producing a prostatitis and perivesiculitis with edema and matting together of the ampulla and vesicle. There is also some edema at the bladder neck. There is considerable suprapubic and lower abdominal tenderness and sometimes rigidity. The perineal pain may be marked and acute urinary retention may develop. Thrombophlebitis of the pelvic plexus may result from severe infections of the prostate and vesicles.

Pyovesiculosis. Empyema of the seminal vesicles, often termed cystic dilatation of the vesicle, has been mentioned before. The vesicle is converted into a closed sac filled with pus. This is due to edema of the ejaculatory duct or occlusion of the same, by plugs of mucus or pus. It may cause acute urinary retention, which is immediately relieved when the contents are evacuated through the ejaculatory duct. This condition of occlusion of the ejaculatory duct with infected vesicles usually precedes an epididymitis. During the acute epididymitis, the distended seminal vesicle which is a pus sac, can be distinctly felt.

Pelvic Abscess in the Male. This may be secondary to an appendicitis or extension from infection of the large bowel. It may also result from extension of

^o See also Chapter 31

infection from the suprapubic space in prostatectomy. It may be secondary to rupture of a prostatic abscess into the ischiorectal space. It is often the result of extension and activation of an acute pelvic cellulitis, secondary to a vesiculitis. As a result of perforation the vesicle may pour its contents into the pelvic cellular tissue and in rare instances even into the peritoneum resulting in a peritonitis.

Pus may burrow between the prostate and rectum and present itself perineally as a perirectal abscess or it may extend anteriorly through the loose tissues between the rectum and the prostate and simulate a periurethral abscess secondary to stricture of the urethra.

The infection may extend into the ischiorectal space and require perineal incision and drainage. It may extend upward pushing the peritoneum in front of it and involve the prevesical space (Fig. 51) and the bladder neck.

Infection around the prostate in prostatic hypertrophy may result in a fairly extensive pelvic cellulitis and abscess. Following prostatectomy an infection of the prevesical space may extend to the pelvis and ischiorectal fossa necessitating through and through drainage from an incision in the perineum to the suprapubic space. Infection about a bladder diverticulum with pericystitis may produce a localized pelvic abscess.

In extensive pelvic cellulitis and abscess formation all the tissues are matted together into an inflammatory mass. We have seen a case in which following prolonged infection in the cavity of the prostate after prostatectomy an erosion of the prostatic urethra resulted from incrustation and stone formation and on extensive pelvic abscess with fatal termination ensued.

Pelvic abscess may extend also in another direction. Extension of a pelvic abscess may occur along the sheath of the vas deferens to the inguinal ring pointing here as has been reported by various writers among them Kocher, and recently by Nielsen. The incision of the abscess at the inguinal ring drains the pelvic abscess and gives relief to the symptoms. These are practically always secondary to a vesiculitis.

Funiculitis secondary to a vesiculitis may present itself either as an abscess at the inguinal ring as mentioned above, or more commonly as an induration and swelling at the inguinal ring. This may follow either an acute or chronic vesiculitis and will be discussed more fully under infections along the sheath of the vas deferens in Chapter 20.

Epididymitis. Except for the small percentage of cases in which epididymitis is of hematogenous origin, this condition always results from extension of infection along the lumen of the vas from an infected seminal vesicle. With persistence of infection, the epididymitis may recur. Epididymitis is the most frequent complication of vesiculitis.

Strictures of the Vas Deferens. These are often found in men suffering with a chronic vesiculitis who give no history nor present evidences of epididymitis. They are probably due to the occasional extension of infection along the vas with resulting inflammation and cicatrization. They are usually found in the scrotal portion of the vas.

The Seminal Vesicles as Foci of Metastatic Infection. Gonorrheal rheumatism in its various manifestations is in the vast majority of cases secondary to an infection of the seminal vesicles. Other metastatic involvements as conjunctivitis and iritis frequently result from foci of infection in the vesicles. This subject has been covered in Chapter 11.

SUBACUTE SEMINAL VESICULITIS

The acute involvement, after subsidence, may persist for many months as a subacute and later chronic vesiculitis. Most of the cases of subacute seminal vesiculitis present very few symptoms during the early stage of the infection.

They are mild in character but persist and give rise to various disturbances, often becoming chronic. The symptoms are similar to those of a chronic vesiculitis.

CHRONIC VESICULITIS

The usual symptoms of chronic vesiculitis are a feeling of fullness and pressure in the perineum, a feeling of congestion at the bladder neck with some degree of urinary frequency, occasional burning in the urethra and pain or pressure in the inguinal regions.

Backache—sacral pain, is also a prominent symptom. As has been stated previously in Chapter 11, backache in the male is always an indication for rectal examination to determine the condition of the prostate and vesicles.

Symptoms

ABDOMINAL PAIN AND TENDERNESS Pain below the level of the iliac spines anteriorly, may result from persistence of infection in the prostate and vesicles. The patient often complains of a feeling of pressure suprapubically. There may be some pain and tenderness on pressure over one or both sides of the lower abdomen. The perineal pain is often referred to the rectum and an occasional itching or burning is commonly complained of.

URINARY SYMPTOMS There may be some burning, pain and itching in the urethra, either in the perineum or near the meatus and this may be intensified upon urination. There is occasionally some burning upon urination. There is usually some degree of frequency, presenting itself during exacerbations as nocturia, two to four times. Urgency may also be present. A morning drop is usually present and there may be a slight discharge at the meatus throughout the day. The persistence of the discharge at the meatus following an acute gonorrhea or the presence of a discharge in the absence of gonorrhea, does not necessarily indicate that the infection is in the anterior urethra. It is a common association of chronic vesiculitis and may be due merely to the vesiculitis.

The first glass shows a clear urine with a few shreds and the second is as a rule clear. There may be a persistent cloudiness of the first glass with the second clear or only slightly cloudy. There may also be intermittent periods of clear urine with a few days in which pus presents itself again. Very often the urine is entirely clear, no discharge is present at the meatus and the patient who has had a gonorrhea is often considered as cured. He, however, still complains of perineal and some suprapubic pain which upon rectal examination, will be found to be due to persistence of vesicular infection.

PHOSPHATURIA The urine of patients suffering with chronic vesiculitis very frequently presents a diffuse turbidity due to phosphates which can be readily cleared up by the addition of a few drops⁷ of acetic or nitric acid. The phosphates normally present in the urine are precipitated through the pouring out of the

⁷ See Chapter 8

alkaline contents of the vesicles and prostate. It may be well to note therefore that not all phosphaturias are of renal origin.

VESICAL ALBUMINURIA. The protein contents of the vesicular secretion consists mainly of globulins, albumoses and nucleoproteins, with their constant excretion into the posterior urethra and then into the bladder mixing intimately with the urine. An ordinary nitric acid ring test (Fig. 261) of this urine or of diluted semen or expressed vesicular secretion will give a precipitate at the point of contact similar to that of albumin but which is due to the precipitated globulins. Above this wide ring due to the globulin, there is a clear area and at the top there is a white cloud of nucleoproteins which the acid has not affected. This vesicular albuminuria was first brought to attention by Belfield.

It can be readily mistaken and is often wrongly diagnosed as albuminuria of nephritis. If the patient be cystoscoped and his ureters catheterized one will find that the kidney urine contains no albumin and will give no reaction to nitric acid. This albuminuria which is really a globulinuria (Fig. 261) is often present in chronic vesiculitis and its presence or absence is usually an indication as to the progress of the case.

Many cases of idiopathic and physiologic albuminuria are probably merely vesicular albuminuria. The albuminuria of adolescence in the male may in an appreciable percentage of cases be due to hypersecretion by the prostate and vesicles.

SEXUAL SYMPTOMS. Some disturbance is usually noted. The patient often has some burning and pain on ejaculation and may feel worse after coitus. In many cases, however, coitus gives temporary relief in evacuating the contents of the vesicles. In some cases the ejaculations may be bloody or blood tinged. Nocturnal emissions are not frequent in chronic vesiculitis except for acute exacerbations.

There is usually a diminution and in many cases, complete loss of sexual desire in long standing infections. Varying degrees of loss of potency and impotency develop. Early rapid "hair trigger" ejaculations are common. Later there may be difficulty in obtaining proper erection and total impotence can result. Erections may also be frequent and painful. With removal of the vesicles the patient becomes completely impotent but this may be only transitory.

NEURASTHENIC SYMPTOMS. These are present in protracted cases and in those who have neurasthenic tendencies. An appreciable number of so-called male sexual neurasthenics are actually suffering with a chronic vesiculitis. The symptoms complained of are vague aches and pains and some pain in the scrotum and thighs. Headache and dizziness are frequent complaints. Various neuroses and types of insanity have been ascribed to chronic vesiculitis, but these are merely coincidental findings.

RHEUMATIC SYMPTOMS. Chronic arthritis and other rheumatic manifestations of gonorrheal rheumatism are due to a persistent focus in the vesicles. These rheumatic manifestations, with metastatic infections such as iritis may also be due to a non-gonococcal infection.

It can be readily seen that the picture of a chronic vesiculitis may be quite varied. Some urinary disturbances and perineal pain with occasional rheumatic manifestations are also present in most cases.

URETERAL AND RENAL COLIC. This is not a rare symptom. Some cases may consult the urologist on account of pain along the ureter and occasional colic,

at an early stage of chronic vesiculitis. The adhesions around the ureter and stricture of the ureter that sometimes occur, account for the upper urinary tract symptoms.

PAIN ALONG THE COURSE OF THE VAS DEFERENS sometimes sharp and cutting and of a transient nature is often noted. Occasionally severe attacks of pain, of a colicky nature along the course of the vas and referred to inguinal region and testicle, are noted. These may last a few hours and incapacitate the patient during the attack.

CYSTITIS A chronic trigonitis and cystitis may result from the outpouring of the infected vesicular contents into the posterior urethra and bladder. Many cases of vesiculitis were in the past erroneously diagnosed as chronic cystitis.

PROSTATORRHEA AND SPERMATORRHEA These are evidences of chronic congestion of the prostate and vesicles and although present at times in chronic vesiculitis, they are usually present in chronic prostatovesiculitis due to non-infectious causes such as sexual excess and continued practice of coitus interruptus. The prostaticorrhea and spermatorrhea may be most marked on defecation or at the end of urination. Some prostatic and vesicular secretion may occasionally be squeezed out and be found at the meatus even under normal conditions, following defecation.

Clinical course of chronic vesiculitis

The symptoms may persist over for months and often years, with periods of remissions and exacerbations. Treatment alters the symptoms and hastens the course. Occasionally after apparent cure, the symptoms may recur, to be again relieved by treatment. In the protracted and severe infections, some permanent damage remains which occasionally produces symptoms.

PROSTATOVESICULITIS OF NON-INFECTIOUS ORIGIN

This is due, as has been mentioned before, to sexual excess, continued use of condoms and continued practice of coitus interruptus, as is frequently seen. The patient complains of some congestion in the perineum, some urinary frequency and very often considerable reduction or complete loss of potency. The chronic congestion in the prostate and vesicles resulting from the causes mentioned, is the cause of the various symptoms. Proper sex habits and a course of massage give considerable relief.

In elderly men who are leading a sedentary life or who have had vesiculitis as young men, it is not uncommon to see a prostatovesiculitis due merely to congestion of the prostate and vesicles or resulting from a "cold" or chronic constipation.

SEMINAL VESICULITIS AND PROSTATIC HYPERTROPHY

"Prostatism" in old men is in many cases due to a chronic congestion or infection of the seminal vesicles.

There is no fibrous prostate or contracture of the bladder neck in these individuals, although such a diagnosis is often made if one depends on negative rectal findings alone. Many patients have been subjected to prostatectomy without being relieved. These patients may have considerable urinary frequency and nocturia with some interference with the urinary stream and a fair degree of residual urine. Many of the cases of "prostatism sans prostate" are of this class.

Vasectomy was a popular procedure before prostatectomy was employed and gave relief in many cases. The results of vasectomy can be attributed to the relief of the vesiculitis rather than to the reduction of hypertrophy of the prostate.

SEMINAL VESICULITIS IN ASSOCIATION WITH PROSTATIC HYPERTROPHY

As has been stated previously in this chapter vasectomy is a routine procedure preliminary to prostatectomy to prevent the development of epididymitis which in the vast majority of cases results from the infected seminal vesicles. Some of the symptoms of prostatic hypertrophy are due to the associated vesiculitis.

It is not at all uncommon to find that some urinary symptoms persist and the urine still remains cloudy following prostatectomy due to the coexistent seminal vesiculitis or to infection of the vesicles following prostatectomy.

DIAGNOSIS OF SEMINAL VESICULITIS

The diagnosis is made by rectal palpation and the examination of the expressed secretions. In many cases the symptoms in themselves are diagnostic but they should always be corroborated by rectal findings.

ACUTE SEMINAL VESICULITIS

This is usually a prostatovesiculitis and it is often impossible to differentiate the symptoms of involvement of the prostate from those of the vesicle infection. Frequent nocturnal emissions with hemato- and pyospermia is diagnostic of vesiculitis. Suprapubic and lower abdominal pain in acute prostatovesiculitis is due to the vesiculitis and not to the prostatitis.

In many cases the prostate is but little affected and the distended indurated vesicles can be readily felt above the upper border of the prostate. In mild infections there is only a slight induration and tenderness of the vesicles. When the infection is acute the induration of the vesicles with the perivesiculitis can be distinctly felt. One vesicle alone may be involved the other being apparently well.

It is common to find the involvement more marked on one side.

In severe and extensive involvement an induration over the vesicle and ampulla can be felt, all of the structures immediately above the prostate being matted together.

In acute prostatovesiculitis with marked bulging of the prostate into the rectum (the prostatitis being parenchymatous or bordering on prostatic abscess) the vesicles can often not be palpated and the vesiculitis may be overlooked in marked prostatic infection. Epididymitis is a frequent complication here. The prostatic infection and enlargement subside rapidly the vesiculitis persisting. This can be detected on rectal palpation by those who have had some experience.

The involvement of the seminal vesicle is quite definite to the finger in the rectum. In the presence of an acute epididymitis and this persists for a considerable time after the epididymitis has subsided. Do not massage the vesicles in acute vesiculitis—palpation is all that is necessary to make the diagnosis. Massage may be followed by an epididymitis or aggravate the inflammation.

SUBACUTE SEMINAL VESICULITIS

With the persistence of symptoms as previously mentioned palpation per rectum and the examination of the expressed secretions will determine the

presence of pathology in the prostate and vesicles The perivesiculitis, and often periampullitis, in the cases with persistent infection associated with an epididymitis, can be distinctly felt Since seminal vesiculitis persists for some time, the induration felt in the acute vesiculitis is still present

The degree of tenderness on massage is of considerable diagnostic value While it is true that individuals vary considerably in their reaction to massage, severe pain and tenderness, particularly if more marked on one side, is very important in establishing the diagnosis The expressed secretions show the presence of pus or muco-pus This will be discussed further under chronic vesiculitis

CHRONIC VESICULITIS

The findings per rectum and the examination of the expressed secretions, both gross and microscopic, establish the diagnosis In some cases, there may be a considerable amount of pus expressed from the vesicles without any apparent pathology, as determined by rectal palpation In others, the symptoms are quite clear and indicative of vesiculitis and there is considerable tenderness and pain on massage with some induration present

Nothing can be expressed until a number of attempts are made The ejaculatory duct is distorted and partially occluded by cicatricial changes and is often closed by plugs of mucus or pus

The indurated vesicles and ampullae together with the involvement in the prostate can, however, be distinctly noted in most cases, involving as a rule, one side more than the other

The expressed secretion which appears at the meatus and which can be collected in a glass or which appears only upon urination after massage, often only at the end of urination, has a gross appearance that is diagnostic The shreds of a subacute or chronic vesiculitis may appear in the discharge at the meatus in the form of long stringy shreds of muco-pus In active infections, the shreds which are often casts of that of the wall of the vesicle, consist of fairly large "chalky" gray appearing shreds, a few in number and varying in size that immediately sink to the bottom of the third glass after massage Microscopically these consist of pure pus After some treatment, the number and size of these pus shreds diminish and consist later of sandy white material that sinks to the bottom of the glass (Plates VI and VII)

With treatment and subsidence of infection, the typical shreds of muco-pus appear upon massage At first, these may show the white or gray shred of pus at one end attached to the shred of muco-pus The pure pus shreds above mentioned may coexist with the shreds of muco-pus This muco-pus, "rubbish," i e, large casts of the seminal vesicles is due to incrustation on its wall These are long flaky shreds "wormy" in appearance, having assumed this form on being squeezed through the ejaculatory ducts They float in the urine and are of different size and conformation They are grossly diagnostic of vesiculitis and can readily be distinguished from semen which appears as a sticky coherent mass in the urine If allowed to remain in the urine for a time, they dissolve as the result of the action of the acid urine on these alkaline shreds Although having the gross appearance of mucus only and floating in the urine for a time, they will invariably be found to contain pus together with mucus Spermatozoa will also be often present in these shreds

The semen As has been stated under the diagnosis of cure of gonorrhea, the study of the semen is the most important determining factor as to the condition of the vesicles. The persistence of infection in the prostate and vesicles can be well determined by occasional examination of the semen. The presence of pus, mucus and bacteria lowers the vitality of the spermatozoa and the frequent finding of dead sperm only is indicative of pathology in the vesicles. This will be more fully discussed in the chapter on sterility.

In the differential diagnosis of backache and lower abdominal pain in the male pathology in the prostate and vesicles should be considered, hence a rectal examination is always indicated.

TREATMENT

The treatment of vesiculitis usually includes the treatment of the prostatitis associated with it and very often the metastatic involvement in which the vesicles are the foci. The complications are relieved, often cured and prevented by treatment directed to the vesicles.

ACUTE SEMINAL VESICULITIS

The majority of acute vesicular infections in gonorrhea are mild and clear up with routine treatment of the posterior urethra. Many, however, become sub-acute and chronic.

Hot sitz baths heat to the perineum in the form of hot water bags, hot towels or electric pads are of considerable value in relieving the congestion and give considerable relief. The hot baths can be taken once or twice daily and when the symptoms are fairly marked the patient should be confined at home or in bed. Rectal suppositories of opium and belladonna one-half grain each help to relieve the tenesmus and urgency. Belladonna and opium may also be given by mouth. Rectal irrigations with hot and cold water often give considerable relief. Vaccines are sometimes of value but as a rule give but little relief. If the symptoms persist or become more marked or urinary retention is impending vasotomy is definitely indicated. This subject has been covered in Chapter 12.

SUBACUTE SEMINAL VESICULITIS

The seminal vesiculitis which persists after three to four months can very often be cured by persistent and thorough treatment. Massage every four to seven days with instillation and irrigation of the posterior urethra combined with the judicious use of vaccines will cure a large number. This should be persisted in for a period of two to three months before surgical measures are employed if no relief is obtained. Vasotomy is then indicated and will cure a number of cases. The arsphenamines, neosalvarsan and sulpharsphenamine are a valuable addition to our therapy and give considerable promise. Some of these cases are promptly cured by a few injections of neosalvarsan.

CHRONIC VESICULITIS

These patients constitute a large percentage of those seen in the practice of every urologist.

Massage Persistent and thorough massage of the prostate and vesicles over a period of a few months clears up most of the infection and in many

cases, cures the patient. There can be no question as to the therapeutic value of massage. Many infections persist, in spite of massage carried on over a period of months. Others are relieved temporarily and then return for treatment because of recurrence of perineal pain and distress at the bladder neck. Some patients with chronic vesiculitis have a recurrence of symptoms at intervals of one to three years, at times even later, and are relieved by a course of massage.

Dilatation with sounds, irrigation and instillation of the posterior urethra medicate the prostate and prostatic urethra and are valuable adjunct therapy with massage. Vaccines are valuable in many cases and should be employed in conjunction with massage. Foreign proteins such as Aolan intramuscularly, have been of some help.

Neosalvarsan and sulpharsphenamine. Neosalvarsan 0.2 to 0.3 Gm intravenously at intervals of four to five days, for a series of five to six doses is apparently of considerable value in the treatment of chronic vesiculitis as reported by Belfield and Rolnick. The rationale for this therapy is not clear, but clinical evidence has substantiated its value in the treatment of chronic vesiculitis.

Diathermy has proven of considerable benefit in chronic prostatovesiculitis and has given relief in many cases where routine treatment helped but little. An occasional hot bath and regulation of the bowels are essential to prevent and relieve congestion of the prostate and vesicles.

Surgical Measures

If the medical measures above mentioned fail, then various surgical measures of which vasotomy is practically the only satisfactory procedure, may be resorted to. Some of the following methods which we believe to be of little value will be cited.

1. **Aspiration of the seminal vesicles** through a needle inserted through the rectum. A few cases have been reported in which large quantities of pus have been evacuated in this manner. It is not without danger, is a blind procedure and has no place in treatment.

2. **Injection about the vesicle through the rectum, of Pregl's solution.** This iodine compound has been recommended by Stellwagon, but has not become popular. He also recommends injection into the prostate through the rectum with the same solution.

3. **Catheterization and injection by way of the ejaculatory ducts.** The direct medication of the seminal vesicles by this route has been advocated and recommended by some urologists. There are, however, various factors which make this procedure of little or no value in the treatment of infections of the seminal vesicles.

- (a) The ejaculatory ducts are often so small (Fig. 50) that they cannot be seen when exposed to the naked eye, at autopsy. A few men with considerable experience in urethroscopy have become skillful in catheterizing the ducts but the urologist with average skill, finds he can do this only occasionally.

- (b) The ejaculatory ducts may open on the lips of the utricle or within the utricle, making catheterization difficult or impossible.

- (c) With prostatovesiculitis, the verumontanum, which is associated in the pathologic process, is inflamed and distorted, the openings of the ejaculatory ducts

are obliterated and the verumontanitis must be treated before the ducts can be catheterized

(d) Considerable trauma to the tortuous rigid ejaculatory duct may occur in catheterization and epididymitis may result.

(e) The most important argument against this procedure is however the following. It has been stated in the beginning of this chapter that the ampulla of the vas deferens is equally involved with the vesicle in the pathologic process. It has been shown that the ejaculatory duct is continuous with the seminal vesicle and not with the ampulla. One of us has shown that fluid injected by way of the ejaculatory duct only fills the vesicle in the vast majority of cases and that it enters the ampulla in only a small percentage. Thus even though the technical and anatomical difficulties be overcome injection of the seminal vesicles by way of the ejaculatory ducts seldom accomplishes its purpose for the ampulla of the vas which is equally involved in the pathologic process is medicated in only a small percentage of cases.

4 Vesiculotomy Incision and drainage of the seminal vesicles through a perineal incision has been replaced by vesiculectomy which is the only logical procedure if resort to major surgery is indicated. The tortuous sacculated vesicles cannot be well incised their entire length, drain but poorly and the purpose of this extensive dissection of the perineum will be defeated, unless the vesicles are removed.

5 Vesiculectomy This is a major procedure and is an operation of last resort after all other measures, particularly vasotomy have failed. The damage to the perineum the extensive procedure and the untoward sequel of total impotence, force one to employ this operation as a last resort. Removal of the vesicles has cured many cases of chronic arthritis.

6 Vasotomy This procedure first proposed by Belfield, has been employed in the treatment of infections of the seminal vesicles. It consists of the injection of the seminal vesicles, by way of the vas deferens with an antiseptic solution. The scrotal vas which is the most accessible portion is injected in this operation (Chapter 50). The ampulla and vesicle are medicated in this manner the procedure being far preferable to injection by way of the ejaculatory ducts in which the ampulla is medicated in only a small percentage of cases.

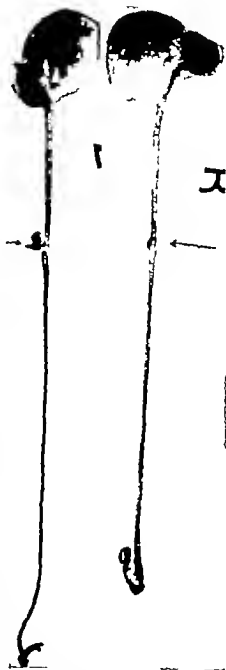


FIG. 262.—Experiment on dogs into whose vasa a 10 per cent colargol solution was injected at points indicated by arrows. Specimens removed three weeks later show patency of vas on both sides as indicated by opaque medium passing through vasotomy level.

Vasotomy is only indicated for non-tuberculous infections of the seminal vesicles. It does not affect any urethral condition.

(a) Recurrent epididymitis. Vasotomy is occasionally indicated for the recurrence of an epididymitis. Recurrent epididymitis is indicative of persistence of infection in the seminal vesicle.

(b) Epididymotomy. Vasotomy should always be done at the time an epididymotomy is performed. "Epididymotomy without vasotomy is like mopping up the floor without turning off the faucet" (Belfield).

(c) Chronic vesiculitis. Before advising vasotomy in chronic vesiculitis, the patient should have the benefit of a course of thorough massage for a period of two or three months and with it or following this, a series of injections of neo-salvarsan. If these measures are unsuccessful, then vasotomy should be performed. It will help in some cases.

(d) Gonorrheal arthritis and other metastatic infections in which the seminal vesicles are the foci. Vasotomy using 5 cc. of 5 per cent collargol, is almost a specific for gonorrheal rheumatism. Metastatic infections are promptly relieved in the majority of cases.

(e) Occlusion of the vas. This may result from considerable trauma to the vas and adjacent tissues or may be due to the injection of very irritating antiseptics. One of us has shown that when it occurs, it may be due to one or both of these factors, but in the vast majority of cases is due to trauma. The resultant sterility from possible bilateral occlusion is the only claim that can be held against the operation. This occurs but seldom, with proper technic and the use of a proper antiseptic. Occlusion, when it develops, occurs at the site of the operation only and is due to the formation of scar tissue in the submucosa as the result of regurgitation of the antiseptic, with resultant compression of the lumen.

The occluded portion can readily be resected and the cut ends reunited (Fig. 262) with restoration of the lumen. This has been shown to be a standard successful procedure both experimentally and clinically.

CHAPTER 20

VAS DEFERENS SPERMATIC CORD EPIDIDYMISS¹

VAS DEFERENS
INFECTIONS
STRICTURES
SPERMATIC CORD
INJURIES
TUMORS

EPIDIDYMISS
ANOMALIES, CYSTS, INJURIES AND TUMORS
INFECTIONS
TUBERCULOSIS OF THE MALE GENITALIA
TUBERCULOSIS OF THE EPIDIDYMISS
TUBERCULOSIS OF THE SEMINAL VESICLES
TUBERCULOSIS OF THE PROSTATE

VAS DEFERENS

Anomalies and abnormalities The vas may vary considerably in thickness. Complete absence of the vas is rare. The ureter may end in the vas or seminal vesicle (Fig. 353). Congenital narrowings and strictures probably occur but have not been studied.

Injuries. The vas because of its protected location and its coverings is rarely injured. It may be accidentally divided or ligated during herniotomy.

Tumors. Fibroma is occasionally seen, this usually involving the spermatic cord. Lipoma has been reported as has also sarcoma.

Cysts. Spermatocoele cysts may arise along the course of the vas. Aberrant tubules, the remains of the Wolffian body, may occasionally persist along its course.

INFECTIONS

The vas deferens may be infected by extension along its wall or its sheath. The infection may extend from the epididymis to the vas or from the seminal vesicle. In the evolution of an epididymitis, the bacteria pass rapidly along the lumen of the vas to the epididymis without involving the vas, but after the epididymitis is fully developed the infection then extends upward by continuity along the wall of the vas, involving very often the entire scrotal and inguinal vas, extending even beyond. The extension of infection along the lumen of the vas has been discussed under gonorrheal epididymitis. (Chapter 11.)

Infection along the sheath of the vas deferens. As stated in the previous chapter, this method of extension of infection from the seminal vesicles has only recently received some notice.

The sheath of the intrapelvic vas is usually not continuous with the sheath of the intrascrotal vas. Each segment merges into the intervening loose connective tissue at the internal inguinal ring which either partially or completely separates them. This loose connective tissue is termed Bogros space. (Figs. 260 and 263.)

The clinical importance of Bogros space has been recently emphasized by Belfield and Rolnick. Infections traveling along the sheath from the seminal vesicles diffuse at this point and produce tender swelling and abscesses. Although these swellings and abscesses in Bogros space have been described by Kocher, Tillmans, Hutchinson and Guteras, as secondary to pelvic abscess, the extension of the infection along the sheath has only recently been demonstrated (Figs.

¹Including tuberculosis of the male genitalia.

264 and 265) by one of us. This mode of extension had, however, been previously suggested by Belfield and the experiments which followed his suggestion, proved it.

Funiculitis. Involvement of all the structures of the cord, due to extension along the sheath from the infected seminal vesicles, has been often mistaken for hernia. Wesson has reported a large number of these pseudo-industrial hernias which disappeared after treatment of the seminal vesicles.

Pelvic abscess may also extend along the sheath and present itself as an abscess in Bogros space. Incision and drainage through the inguinal ring may clear up the infection in the pelvis, about the vesicles. When the scrotal and pelvic vas are continuous, the infection may traverse the entire sheath of the vas until it enters the tunica vaginalis testis. At this level the vas loses its sheath, the latter then enveloping the tunica. A funiculitis of the entire spermatic cord may occur and the infection may extend to the tunica vaginalis producing a periorchitis.²

Aside from infection along the sheath of the vas, funiculitis (inflammation of all the structures of the spermatic cord) may result from other causes. The entire spermatic cord may be involved in an abscess within the scrotum, and require incision and drainage. It is also often diffusely involved in severe gonorrheal epididymitis. Funiculitis as the result of hematogenous infection has been reported. Secondary infections following operations for varicocele are not uncommon. Thrombophlebitis of the pampiniform plexus may result in an abscess involving the entire cord. Funiculitis occurring in filariasis may result from extension along the sheath of the vas.

ACUTE FUNICULITIS presenting itself as a painful swelling over the internal ring, may be mistaken for an incarcerated inguinal hernia and is not rarely confused

with an inguinal adenitis. Chronic funiculitis—often mistaken for a hernia—the pseudo-industrial hernia, can readily be differentiated on careful examination. The importance of rectal examination in these cases which are secondary to a vesiculitis and due to extension along the sheath of the vas, is evident. In funiculitis, the vas can be felt as a hard, thick cord, this being particularly marked after gonorrheal epididymitis.

Vasitis or Deferentitis. In association with a gonorrheal epididymitis, the entire spermatic cord or the vas alone may be involved. The induration and thickening of the vas, often associated with gonorrheal and other types of epididymitis, is due to inflammation of the entire wall of the vas. This and similar involvement is termed vasitis or deferentitis.



FIG. 263—This illustration demonstrates that opaque medium (fifty per cent sodium iodide) injected from the sheath of the seminal vesicle extends along the pelvic portion of the vas until it ends in Bogros space at internal ring.

² See Chapter 21

STRICTURES

Strictures of the vas deferens are quite common and are found in the vast majority of cases in the scrotal portion of the vas i. e. that portion extending up to the inguinal ring and for an inch or two, beyond. Belfield found strictures of the pelvic portion of the vas in one per cent of vasotomies. Strictures of the vas produce obstructive sterility on the side involved. If they are complete. Many, however, cause only some narrowing of the lumen but not complete obstruction. The vast majority of the strictures are the result of vasitis in association with gonorrheal epididymitis. The strictures are usually multiple. The sheath of the vas is often encased in scar tissue and is adherent to the vas at the point of



FIG. 264—A. Cross section of a human vas near the ampulla showing the distinct space between the vas and its sheath (that permits organisms to pass along the outer wall of vas). B. Cross section of the same human vas deferens in the spermatic cord demonstrating also, the space between the vas deferens and its sheath and showing continuity of sheath.

stricture. Tuberculosis will produce strictures of the vas with occlusion. The nodules of tuberculosis in the vas usually completely occlude. Very often, however, the duct may remain patent and the patient still be fertile. Injuries to the vas in accidents, surgical operations and as the result of trauma and injection of strong irritants in vasotomy are other causes of stricture.

Strictures of the vas are often encountered in attempting vasotomy for chronic vesiculitis in men who give no history and present no evidence of epididymitis. These are usually bilateral, are located in the scrotal vas and may be analogous to the ureteral strictures in the lower portion of the ureter mentioned by Hunner and others.

The diagnosis of strictures of the vas is only made at operations such as short-circuiting the vas deferens or in attempting vasotomy. Many are only partial strictures and can be relieved by passing a silkworm gut through or are sometimes overcome by forcing the blunt vasotomy needle through. Others may be impervious to silkworm gut but readily permit water or other fluid to pass. Those that completely occlude the lumen require resection. Resection of a stricture of the scrotal vas, with anastomosis of the cut ends, has been successful with restoration of the lumen both clinically and experimentally. Strictures of the pelvic vas are inaccessible and cannot be repaired.

SPERMATIC CORD

INJURIES

These are rare except for those due to various operations. Failure to develop complete hemostasis when the pampiniform plexus has been injured may result in a large hematocele of the cord. This may also result after herniotomies and varicocele operations. If the pampiniform plexus alone has been ligated, the artery accompanying the vas deferens will usually be sufficient for the blood supply of the testicle. Very often, however, ligation and severing of the pampiniform plexus to relieve varicocele, results in atrophy of the testicle and hydrocele.

In herniotomy, a tight inguinal ring and the transplantation of the cord often results in compression of the cord. Atrophy of the testicle is not rare and hydrocele may result. Ligation or division of the entire spermatic cord results in complete atrophy of the testicle and very often gangrene. Ligation or division of the vas deferens alone, has relatively little effect on the testicle. When the vas has been divided or torn, the two ends can be reunited with complete restoration of the lumen. This regenerative capacity applies to a varying degree to all epithelial lined ducts and is quite marked in the case of the vas deferens, especially so if the sheath of the vas is also reunited, as one of us has demonstrated (Figs 265 and 266).

Torsion This occurs more frequently than is suspected and many cases are wrongly diagnosed. It is caused by a twisting of the spermatic cord (Fig 267) and is not a torsion of the testicle itself, as often described. This twist, which shuts off the blood supply to the testis and epididymis, may make a quarter or half turn and not uncommonly the cord may be twisted completely around, two or three times.

The etiology is still somewhat obscure, but the majority of torsions occur in testicles that are ectopic or abnormally motile. Torsion usually is found between the ages of fifteen to twenty-five and there is frequently a predisposition on both sides, so that a patient having experienced it on one, may develop it on the other side, as we have recently had occasion to see in a case. The exciting cause is either a violent strain or some direct trauma.

Pathology The torsion is in the cord in most cases immediately above the tunica vaginalis testis. In many, however, the torsion is intravaginal being due here, probably, to a long mesorchium. The twisted cord is swollen and edematous (Fig 267) and shows evidence of gangrene below the twist.

The testicle also shows evidence of gangrene in various portions. When once seen, the specimen usually presents a classical picture which cannot be forgotten.

Symptoms Torsion of the cord develops suddenly and presents severe symptoms. Chronic or relapsing torsion is sometimes seen.

ACUTE TORSION is characterized by severe sudden pain in the testicle with rapidly beginning swelling. The contents of the scrotum are extremely tender and signs of inflammation develop. General systemic reaction also occurs, with nausea, vomiting, abdominal pains and fever. The torsion may untwist itself but this is rare. When this occurs, the symptoms recede. In nearly all cases the symptoms persist and the swelling of the scrotum becomes more marked.

As stated previously the condition often remains undiagnosed. If the clinician has seen a few cases he will not be apt to overlook them. The diagnosis is often that of strangulated hernia. Acute severe epididymitis and acute orchitis are also frequently mistaken for torsion and vice versa.

CHRONIC OR RELAPSING TORSION, rarely seen presents itself as recurring attacks simulating acute epididymitis. The cord untwists itself within twenty-four hours or in some cases, the patient learns to untwist the cord himself. In a routine examination of a large number of patients we have seen many cases of atrophy of the testicle in which the cause has been stated to have been some form of trauma. Many

FIG. 265



FIG. 266



FIG. 265.—Regeneration of vas after ligation. Vas deferens, epididymis and testis of a dog removed ten days after ligation of vas at point indicated by arrow. Opaque solution (fifty per cent sodium iodide) was injected from above (proximal) to point of ligation. Note patency of area which had been ligated.

FIG. 266.—To illustrate regeneration of the vas deferens in dog, following transverse division of vas and its sheath. The divided ends were united and dog killed seventeen days later. Note patency at point of anastomosis of vas as indicated by ability to inject opaque medium into vas and epididymis from an opening above level of anastomosis.

of these were probably due to torsion of the cord. Negative findings on rectal examination help exclude epididymitis or infection within the scrotum or of the spermatic cord.

Treatment The treatment is surgical. If diagnosed early, within the first twelve to twenty-four hours, it may be possible to untwist the cord, with restoration of the circulation of the testicle. Usually it is impossible to untwist the cord because the operation is, as a rule, not done until two or three days have elapsed, when gangrene has already begun, so that orchidectomy is necessary. If not operated upon, atrophy of the testicle is the usual end result.

Abnormal mobility of the other testicle, due to a long gubernaculum, is usually present on the other side, hence a fixation of the other testicle is therefore advisable, to prevent possible torsion of the other side. Removal of the

FIG 268



FIG 267



FIG 267—Photograph showing gangrene of the testis owing to acute torsion of the spermatic cord
FIG 268—Varicocele (left) causing wormlike elevations of skin of scrotum (R. Demel)

testicle and cord is usually the only possible procedure because the diagnosis of torsion is made too late.

Tumors These are not common. Lipomata are most frequent and may be mistaken for properitoneal fat in an inguinal hernia. Careless removal of properitoneal fat mistaken for lipoma of the cord, may injure or open the intestine. Fibromata are also occasionally seen. They appear as solid hard tumors and may be attached to the blood vessels or the vas. A few cases of sarcoma, lymphangioma and myxoma have been reported. A mass may form around paraffin, injected to cure a hernia.

HYDROCELE OF THE CORD⁴ This presents itself as an encysted sac which is shut off below by the tunica vaginalis and may extend up to the peritoneum⁴. The hydrocele is entirely extravaginal and may be uni- or multilocular. The sac is closely adherent to the vas and can be pushed up some distance, at times into the inguinal canal. It is usually found early in life. The sac filled with fluid

⁴See Chapter 21 for various forms of hydrocele

and at times quite large may be present in the scrotum alongside the testicle, but separate from it and outside of the tunica vaginalis.

The diagnosis can be made by its fluctuation, ability to grasp its upper and lower poles and transillumination⁵ Aspiration establishes the diagnosis These hydroceles recur rapidly following aspiration Many disappear spontaneously after some years others require operative interference with excision of the sac

A hydrocele of an old hernial sac may present itself at the cord The neck or a distal portion of the sac has remained behind and has been closed off by the closing of the internal ring Amputation of the sac is indicated It is often mistaken for a recurring hernia.

VARICOCELE⁶ This is a dilatation and elongation of the veins of the pampiniform plexus. Varicocele is probably the most common affection of the male genitalia. It usually occurs in a mild form presenting no symptoms Fifteen to twenty per cent of all young adults are found to have some degree of varicocele It is most common between fifteen and twenty five It is rare in infancy In middle-aged and in elderly men it may persist in moderate degree but cause no inconvenience It is practically always found on the left side (Fig 292) The usual explanation for this is that the left testicle hangs lower than the right and that the left spermatic vein does not empty directly into the vena cava as does the right but empties into the left renal vein The valves of the veins become incompetent and dilate There are other factors in the production of varicocele about which considerable theorizing may be done but which are but little understood.

It is unusual to find varicocele in married men who are having satisfactory sexual relations. Most varicoceles are found in young unmarried men and the chief factor is ungratified sexual desire Associated with it are the unrelieved erotic fancies. These, if prolonged produce engorgement of the veins with resultant dilatation Slight varicocele is very often a sexual derangement due to the factors mentioned and is sometimes a result of sexual abuse. Proper sexual hygiene will alleviate many of the cases of the common mild type of varicocele

Diagnosis. The varicocele appears as a tortuous wormy mass (Fig 268) often visible through the skin. It disappears when lying down. The testicle is hypersensitive. There is often a feeling of dragging or of a painful sensation in the groin. Aside from this there are only symptoms of sexual neurasthenia, mental depression headaches and nervousness Inability to concentrate and other vague symptoms have also been mentioned. Occasionally a varicocele becomes large enough to cause distress and require surgical interference. The varicocele is of gradual onset the symptoms of neurasthenia developing gradually Impotence never results from varicocele In long standing cases of marked varicocele the testicle may atrophy The vast majority of varicoceles improve after a few years and almost spontaneously after marriage

Treatment. Proper sexual hygiene is most important. Many patients with large varicoceles present no symptoms others with small varicoceles complain of many symptoms Proper fitting support for the scrotum a suspensory bandage will relieve most cases. Marriage will usually cure the patient of his symptoms

See Chapter 21

We are indebted to the excellent article on this subject in Keyes U ology in the preparation of this section

Operation is inadvisable and should not be done except in those with large varicoceles, who present symptoms. The operative results of varicocele are not always satisfactory and a not infrequent complication of operation is hydrocele or atrophy of the testicle. When definitely indicated, operation gives relief.

Symptomatic Varicocele This is occasionally seen with tumor of the kidney.⁷ A varicocele on the side affected is due to pressure on the spermatic veins and was formerly held to be a diagnostic aid when present, in tumor of the kidney.

EPIDIDYMIS

ANOMALIES, CYSTS, INJURIES AND TUMORS

Anomalies and Malformations Absence of the epididymis is usually associated with absence of the corresponding testicle. Other developmental anomalies are associated with anomalies of the testicle, kidney and ureters. Some embryonic rests are usually found at the head of the epididymis and also aberrant tubules, emanating from the head or from the rete testis. These aberrant tubules often become distended to form blind sacs containing spermatozoa.

Hydatid of Morgagni This is a cyst attached to the testis located at the head of the epididymis and was originally the upper end of the mullerian duct.⁸ It is very small, of soft consistency and has no duct leading from it to the epididymis. In some cases it may reach the size of a small marble and be freely movable at the head of the epididymis. A sessile hydatid may cause acute recurrent symptoms due to torsion. We have operated on two cases diagnosed preoperatively, the symptoms in the early case resembling torsion of the cord.

Paradidymis This represents the remains of the posterior lower half of the wolffian body⁹ and is called the organ of Giraldez. It is usually found at the tail of the epididymis and is not directly connected with either the testicle or epididymis.

Aberrant Ducts The vas aberrans of Haller at the tail of the epididymis, is almost always present. An aberrant tubule is also commonly found at the head of the epididymis.

Spermatocele Cysts containing spermatozoa are common. They are a frequent postmortem finding. Routine examination by us of over fifty thousand men during a period of years has shown the incidence of spermatocele clinically, as that of one per cent of all adults. These cysts are the dilated ends of aberrant tubules communicating either with the rete testis or emanating from the head of the epididymis (Figs 269 and 270). The blind end has become filled with spermatozoa. Experimental and clinical observations by one of us, has shown that they are the result of dilatations of aberrant tubules, due probably to secretory pressure.

The reason for the rarity of spermatoceles in private and clinic practice is that they are usually of small size, symptomless, of no clinical importance and as a rule, careful palpation of the scrotal contents is not made unless there be indications. In many cases, when of appreciable size, they are mistaken for hydrocele of the tunica vaginalis or cord, although these cysts are apparently more common than chronic hydrocele. The vast majority of these cysts are

⁷ See Chapter 43

⁸ See Chapter 1

⁹ See Chapter 1

located above the head of the epididymis and are extravaginal. They are most common in men between thirty and fifty although seen frequently in old men. They vary considerably in size from that of a small marble to a sac which is larger than the testicle.

When the scrotum contains two structures seemingly alike one above the other and united by a broad base the upper one is the spermatocele and the lower the testicle. These large cysts with thick walls have been frequently diagnosed as a supernumerary testicle only a few proven cases of which have been

FIG. 269



FIG. 269.—Autopsy specimen of epididymis and testis. Note epididymis partly dissected. A spermatocele is to be seen attached to the epididymis by a tubule whose outer extremity has dilated to form the spermatocele.

FIG. 270.—Spermatocele sac removed intact. Note tubule on anterior wall of sac whose blind extremity has become dilated to form the spermatocele.

FIG. 270



reported. It is probable that many of the reported cases of a third testicle were really spermatoceles.

The diagnosis is made by puncture and aspiration. The fluid of the cyst containing spermatozoa in varying numbers has a gross appearance that is diagnostic. The typical appearance of the fluid resembles soapy water. In some the contents is clear and contains only a few spermatozoa; others are slightly gray and the thick fluids have the appearance of semen and contain sperm. The fluid is never straw colored as in hydrocele and contains globulins but no albumin. A few sperms in the thicker fluid cysts are usually found to be motile. These spermatocele cysts may also be found anywhere along the epididymis or vas deferens. Cysts which do not contain spermatozoa are also frequently encountered. These were probably spermatoceles originally but as the result of the occlusion or atrophy of their duct the spermatozoa have disappeared. The large spermatocele cysts occasionally require operative interference. They are dissected out with great difficulty, being usually incompletely removed. They tend to recur unless a large part of the wall of the sac is removed.

Hydrocele of the Epididymis An encysted hydrocele may form between the tunica vaginalis covering the epididymis and the latter. They are rare and usually of no clinical importance.

Injuries of the epididymis may be limited to this organ but are usually associated with injuries to the testicle.

Tumors Malignant tumors of the epididymis are frequently associated with tumors of the testis. Some cases of embryonal carcinoma are primary in the epididymis. Lipoma, fibroma and myxoma may also occur.

INFECTIONS

Epididymitis is far more common than orchitis. Many still speak of orchitis as indicating any inflammation within the scrotum. In some cases, both the testicle and epididymis are involved, the orchitis as a rule being secondary to the epididymitis, although the opposite may also be the case.

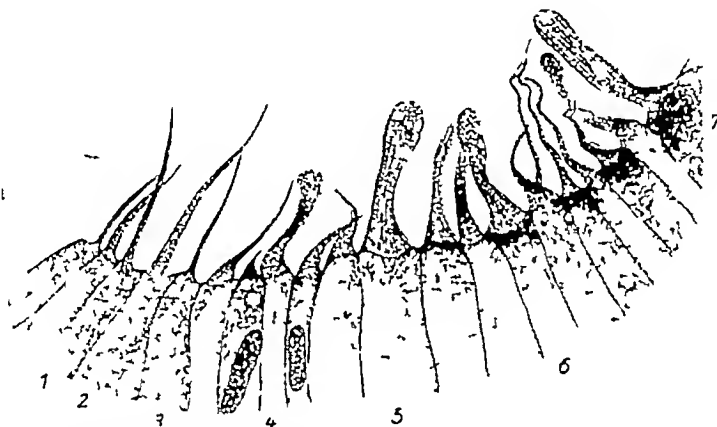


FIG 271—Secreting cells of human epididymis, sectioned immediately after removal from the living body, 1-3, cells at rest, 4-7, cells swelling with secretion (From Heidenhain and Werner *Ztschr f d ges Anat*, 72 556)

We will reiterate here some of the salient points of the physiology of the epididymis because they have an important bearing on infections of this structure. Aside from being a duct through which the sperm passes, it is a secretory organ, its secretions constituting the bulk of the semen (Figs 271, 272 and 273). It is also an excretory organ as Belfield and Rolnick have recently shown. The body of the epididymis excretes substances taken from the blood (Fig 274). This is a function of the epididymis not previously demonstrated. Bacteria may also be excreted in the same manner. Since the epididymis, in the seminal tract, is analogous to the kidney which is quite frequently infected through the blood stream, so bacteria may be excreted by the epididymis with very little damage to its structure.

MODE OF INFECTION

Most of the infections of the epididymis are secondary to infections of the seminal vesicles, the extension of the infection along the lumen of the vas deferens being the mode of involvement. Hematogenous infection occurs in a small percentage of cases and as has been stated previously, the vesicles may be in-

fects as the result of passage of bacteria from the epididymis through the vas deferens. Extension of infection from the testicle may secondarily involve the epididymis and other infections of the scrotal sac may also secondarily infect the epididymis.

The most frequent etiologic factor in the production of epididymitis is gonorrhea. Various estimates of the incidence of gonorrheal epididymitis as a complication of gonorrhea, as 5 to 8 per cent, indicate its importance. Gonorrheal epididymitis has been discussed at length in Chapter 11. The mechanism of epididymitis as resulting from a condition simulating ureteral reflux has also



FIG. 272.—Secreting cells of human epididymis. D discharging droplets of secretion, A which liberate granular masses, B C sperms floating in lumen (From Heidenhain and Werner)

been mentioned. Any condition which incites an infection of the seminal vesicles is an etiologic factor in the production of an epididymitis. With the exception of hematogenous infection epididymitis is always secondary to an infection of the seminal vesicles. Thus a posterior urethritis, prostatitis or cystitis which secondarily involve the seminal vesicles are indirect causative factors. The inciting factor is an edema of the ejaculatory duct the contents of the seminal vesicles thus finding no means of egress are forced down along the lumen of the vas to the tail of the epididymis (Fig. 275). Infections of the epididymis may be acute or chronic the latter which is less frequent seldom being a continuation of the acute process.

PATHOLOGY

The pathologic changes in acute epididymitis are almost identical with the different infecting organisms. The associated inflammation of the scrotal contents, except the testicle, and the infection of the spermatic cord, has already been mentioned under gonorrheal epididymitis. It is important to note that the testicle is frequently not involved, irrespective of the infecting organism. The tail of the epididymis is the main site of the infectious process, the rest of the structure being far less involved. Experimental and clinical observations by one of us, has shown that the infection even at the tail, is not intratubular but is interstitial and peritubular (Fig 276), and that the infection spreads to the rest of the epididymis by interstitial and peritubular extension and not through the



FIG 273.—Secretion by the epididymis of dog. Above microphotograph shows nonstaining globules of secretion in the lumen of the tubules which are filled with spermatozoa.

lumen of the epididymis. The tubule above the tail is usually markedly dilated (Fig 277) and often filled with sperm. It is evident that the damage to the tubule, so often resulting in occlusion of the duct, is due to interstitial and peritubular inflammation which produces abscesses or marked exudation, and these in turn, destroy the tubule or compress it. The later formation of scar tissue about the tubule is due to the interstitial inflammation and occludes its lumen. In long standing infections, there is some intratubular involvement of the tail.

Erotic Epididymitis The swelling, pain and tenderness in the epididymis following ungratified sexual excitement is an episode of common experience. This is usually transient and disappears within a few hours. When often repeated, as during a matrimonial engagement, such symptoms may attain a degree and duration justifying the term erotic epididymitis.

This condition is, in fact, not an epididymitis. Bacteria and in some cases, protozoa, are always necessary for the production of an epididymitis. We have

shown that it is impossible to produce a chemical epididymitis except by the injection of highly irritating substances. It is possible that active secretion within the epididymis during prolonged ungratified sexual excitement may distend the tubule and produce the symptoms. The more likely explanation however is the regurgitation of the contents of the distended seminal vesicles that have not been emitted down to the tail of the epididymis and not beyond. The erotic type of epididymitis may persist for twenty four to forty-eight hours and then completely disappear.

Hematogenous Infections of the Epididymis. It has been the generally accepted opinion that hematogenous infections attack the testicle rather than the epididymis. The recent demonstration of excretion by the epididymis (Fig. 274) and the frequent observations of various blood borne infections attacking



FIG. 274.—Testis and epididymis of dog into whose vein silver arsphenamine has been injected. Body of epididymis shows presence of salt head and tail do not. (Jour Amer Med. Assoc., 89: 2106, Dec. 17, 1927.)

the epididymis show the hematogenous route to be a frequent mode of invasion. Tuberculosis of the epididymis which is hematogenous in origin will be discussed separately later. The chronic infections of the epididymis other than tuberculosis which are frequently seen and termed simple or nontuberculous inflammations are probably in the vast majority of cases of hematogenous origin.

In acute hematogenous infections *B. coli*, staphylococci and other organisms may be found in the abscess. Sometimes the infection is quite marked with complete destruction of the epididymis and involvement of the testicle. We operated on one case in which the epididymis was entirely destroyed. There occur occasionally some mild infections of the epididymis without a previous

history of urethritis, probably of hematogenous origin. These clear up within a few days. As has been stated previously, the epididymis, like the kidney, may excrete bacteria with very little or no damage to its structure, this process being symptomless. Endameba have been found in the epididymis. We have seen a number of cases of syphilis of the epididymis, usually associated with involvement of the testicle. A few of these, however, were apparently limited to the epididymis.

Chronic Simple Epididymitis (non-tuberculous) This is an epididymitis with an insidious onset, developing gradually and persisting for months, occasionally even years, in which there is no history or evidence of a previous urethritis. They are often diagnosed as tuberculosis of the epididymis and the differential diagnosis between

FIG 275

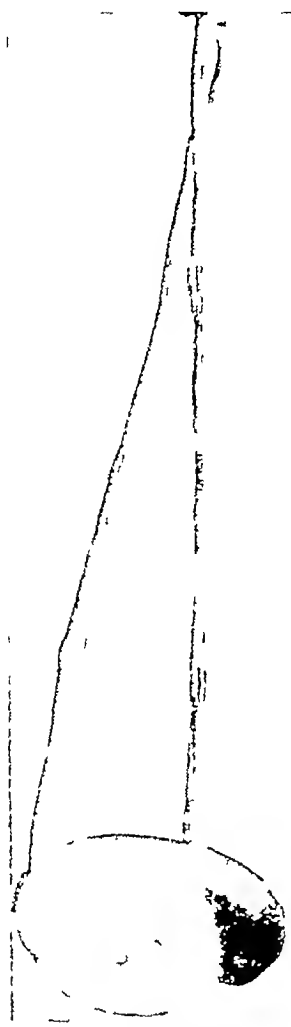


FIG 276

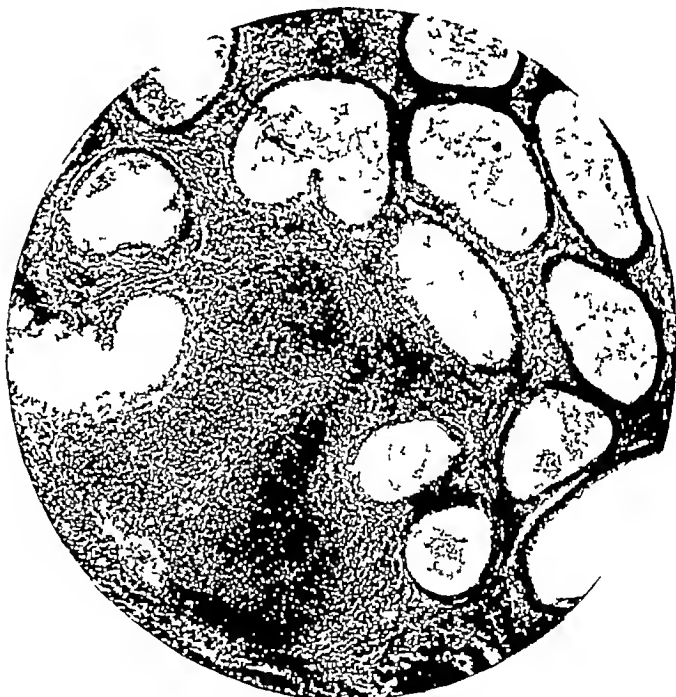


FIG 275—Radiograph of injected vas and part of epididymis. No fluid can be injected beyond tail of epididymis.

FIG 276—Pathology of acute epididymitis. Note that the inflammation is interstitial and not intratubular. Microphotograph of section taken from tail of epididymis of a dog injected through the vas with a culture of bacillus coli and specimen removed four days later.

simple and tuberculous epididymitis is in many cases made only after pathologic examination.

IN THE ABSENCE OF A PREVIOUS HISTORY OF URETHRITIS OR VESICULITIS, THE MOST LIKELY INFERENCE IS THAT MOST OF THESE INFECTIONS ARE OF HEMATOGENOUS ORIGIN. If there is pathologic evidence of greater involvement of the head or body than the tail of the epididymis, it would indicate hematogenous infection.

THE DIFFERENTIATION BETWEEN TUBERCULOUS AND SIMPLE EPIDIDYMITIS as given by Stevens can be made on the following observations:

1. Double epididymitis, found upon examination, slightly favors a diagnosis of tuberculosis.

2 A prior orchidectomy or epididymectomy almost invariably means tuberculosis.

3 A scrotal sinus of over one month's duration is probably tuberculous.

4 Tuberculosis elsewhere in the body means genital tuberculosis in over 90 per cent of cases.

The rectal findings are important. If the lesion is a few months old and there be definite evidence of involvement of the prostate and vesicles this also indicates tuberculosis. The symptoms of simple chronic epididymitis are pain and swelling in the scrotum and pain referred to the inguinal region. Slight urinary symptoms

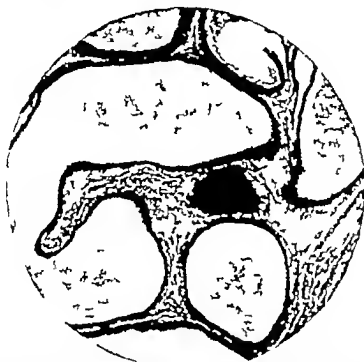


FIG. 277.—Pathology of acute epididymitis. Microphotograph (high power) of section from body of epididymis of a dog injected with staphylococcus aureus through the vas. Specimen removed four days later. Note interstitial abscess and marked dilatation of tubule. This demonstrates that the extension of the infection is by way of the interstitial tissue.

may be present. If the condition persists and the pain and tenderness are more or less distressing epididymectomy is indicated.

Gonorrheal Epididymitis. This has been discussed in Chapter 11.

Recurrent Epididymitis. This indicates a persistence of infection in the seminal vesicle and may develop with nongonococcal as well as gonococcal infection. Two or more recurrences are not rare, some trauma to the posterior urethra usually causing the recurrence. It is not an uncommon experience for an acute epididymitis which is apparently subsiding to flare up again. This recrudescence is usually due to a localized abscess in the epididymis that has again become active.

Nongonorrheal epididymitis, due to infections of the urethra, prostate and vesicles other than the gonococcus is frequently observed. The onset is usually acute.

Acute epididymitis is a frequent complication of prostatectomy. The seminal vesicles have already been infected or become infected at operation, the added trauma to the posterior urethra irritating the epididymis. As has been

ated previously, vasectomy is becoming a routine procedure in these cases for the prevention of such an epididymitis

Chronic infections of the posterior urethra and cystitis, associated with chronic retentions due to bladder neck obstructions, may also be causative factors of epididymitis. Cystitis associated with chronic distention due to injuries to the spinal cord or atony of the bladder, may sometimes be complicated by epididymitis

Catheterization or the passage of a sound in the presence of an infected posterior urethra may light up an epididymitis. The use of a retention catheter and repeated catheterization are more likely to produce an epididymitis than occasional catheterization. Trauma from the attempt to pass a sound or catheter in the acute urinary retention of prostatic hypertrophy or that of acute prostatovesiculitis, may also be a causative factor. Patency of the ejaculatory duct with the entrance into it of urine from the posterior urethra, may allow the infected urine to be forced into the epididymis. Too vigorous massage or the sudden activation of a chronic vesiculitis may cause an extension to the epididymis. In all of these infections the route of the organisms is from the infected seminal vesicle to the tail of the epididymis through the lumen of the vas deferens

SYMPTOMS

Acute Nongonorrheal Epididymitis These are similar to those of acute gonorrheal epididymitis. The local symptoms may be slight or severe and there may be very little or fairly marked systemic reaction as has already been mentioned under gonorrheal epididymitis. The epididymitis usually persists longer than in gonorrhea and a large localized abscess is far more common, often requiring epididymotomy. The acute epididymitis complicating prostatectomy or preceding it, is often a serious complication in these old men, the added disturbance often leading to a fatal termination. In most cases, however, they recover. Frequently the epididymitis becomes chronic, with marked induration and thickening most noticeable at the tail persisting for many months.

The epididymis is somewhat tender on palpation, usually indicating the persistence of infection. Epididymectomy and even orchidectomy is occasionally necessary.

The organisms usually found in these cases of acute nongonorrheal epididymitis are the colon bacillus and the staphylococcus¹⁰. Treatment is similar to that of gonorrheal epididymitis as given in Chapter 12.

Chronic Epididymitis as a Sequel of Acute Epididymitis The persistence of an induration at the tail of the epididymis for months and years after a gonorrheal epididymitis is merely an evidence of fibrosis as a result of the interstitial inflammation. This is really not an epididymitis but merely a scar and requires no attention. Occasionally the patients will continue to complain of severe pain and distress. So-called "neuralgia of the testicle" is very often a symptom of chronic epididymitis. Adhesions of the epididymis to the tunica vaginalis with obliteration of the digital fossa and formation of cysts of the epididymis, may cause persistence of pain. A chronic hydrocele may develop as the result of the persistence of slight infection in the epididymis. The majority

¹⁰ The testis is also frequently involved. Abscess formation of variable extent may destroy the entire testis proper.

of cases of chronic hydrocele are due to a low grade infection of the epididymis developing insidiously after a urethral infection. If no relief is obtained with conservative measures epididymectomy is sometimes indicated and is followed by considerable or complete relief of symptoms.

TUBERCULOSIS OF THE MALE GENITALIA

SOURCE OF INFECTION

Tuberculosis of the genitalia is always secondary to a tuberculous focus elsewhere usually the lungs. As stated previously in Chapter 19, it is our opinion and that of most other urologists that tuberculosis of the genitalia is nearly always primary in the epididymis. Tuberculosis of the male genitalia can be compared with tuberculosis of the urinary tract. The kidney is the primary seat of the infection in the urinary tract and there is early extension down the ureter¹¹ to the bladder. In the male genitalia the epididymis is first attacked with extension along the vas and later involving the seminal vesicle. Nephrectomy relieves the source of the urinary tract infection and usually cures the tuberculous ureter and bladder. Early epididymectomy cures the incipient tuberculosis of the vas deferens vesicles and prostate.

Some urologists are of the opinion that tuberculosis of the genitalia is very often primary in the seminal vesicles. Although hematogenous infection of the vesicles may occur it is rare. Excretion of tubercle bacilli as well as other bacteria by the epididymis with very little damage to its structure, similar to excretion of bacteria by the kidney and secondary involvement of the seminal vesicles may account for some of the reported clinical cases of apparently primary tuberculosis of the seminal vesicles.

Tuberculosis of the genitalia may be secondary to tuberculosis of the urinary tract. In these cases the extension from the tuberculous bladder and posterior urethra involves the seminal vesicles and prostate first and the epididymis only later. Tuberculosis of both the urinary and genital tract is very often found in the same individual so that the condition can be properly termed urogenital tuberculosis.

A few isolated cases have been reported of primary tuberculosis of the prostate and also rare instances of primary tuberculosis of the testicle. The testicle is practically never involved primarily becoming affected secondarily only by extension from the epididymis. The testicle apparently has considerable immunity or resistance to the tubercle bacillus the gonococcus and other hematogenous infections which attack the epididymis rather than the testicle. A possible explanation of this resistance may be that the testicle which is the vital organ for the propagation of the species may have developed during the ages an immunity to the gonococcus and tubercle bacillus, because these diseases have afflicted man through many generations.

CONCOMITANT TUBERCULOSIS ELSEWHERE IN THE BODY Of sixty six cases of tuberculous epididymitis operated on¹² at the Mayo Clinic from January 1, 1918 to January 1, 1923 twenty nine (43.5 per cent) had other tuberculous lesions such as pulmonary vertebral arthritic and renal. The last named con-

¹¹ See Chapter 41.

¹² V. C. Hunt, *Ann. Surg.*, 1924, 8: 811 (May).

comitant localization is of much importance from the clinical standpoint as we shall see later Sixteen of the sixty-six (24 per cent) had such a coincident renal tuberculosis Walthard¹³ quotes the following as to the frequency with which renal and genital tuberculosis are associated Mayo Clinic 36.3 per cent, Bachrach 20 per cent, Beck 19.3 per cent, Burns 15 per cent, Haas 8 per cent (all in the living) and Simmons (from autopsy material) 52 per cent in the male and 9 per cent in the female

Bilateral Occurrence There is a little difference of opinion as to the fact that involvement of both epididymes at an early stage (clinically at least) is rare Usually there is an interval of months to years before the other side presents clinical evidences of involvement Haas reports only four cases of early bilateral localization, out of 125, and Reinecke six in ninety (6.6 per cent)

AGE

The majority of cases are found both at autopsy and clinically, between the ages of twenty and forty That tuberculous epididymitis occurs at an earlier age, there can no longer be any doubt, but it is relatively uncommon in children The majority, at this period of life, are found during the first year and a few cases have been described in the newborn Sebileau and Descombs found that of ninety-one cases in children, forty-two were between birth and the end of the second year and forty-seven between the latter age and fifteen According to some, the testis is first involved in children but primary epididymitis both uni and bilateral, has been found Eisenstaedt¹⁴ has reported a typical case of primary involvement of the testis at the age of three

PREDISPOSING CAUSES

General Any lowering of the body resistance such as excesses (sexual and alcoholic), poor nutrition, overwork, intercurrent infections and heredity, favor localization of the tubercle bacillus in both the urinary and genital tracts

Local This has become a question of much interest from the medicolegal standpoint Of 676 cases of genital tuberculosis in the male in Switzerland, 115 or 17 per cent claimed that the condition was first noticed after some form (crush, blow, strain while lifting, falls, etc.) of local trauma The general opinion is that there is probably a recrudescence of an old focus in such cases

THE RELATION OF GONORRHEA TO TUBERCULOSIS of the male genitalia in general and of the epididymis in particular, has been actively discussed It is well known that a gonorrheal infection of the epididymis is not infrequently followed by tuberculous epididymitis We have observed a case which followed the acute course to be mentioned shortly, under clinical pictures In this case there was a urethral discharge containing gonococci and the typical findings of an epididymitis with fistula formation in the scrotum At operation both gonococci and tubercle bacilli were found in the epididymis and at a later period, in the kidney

RENAL AND GENITAL TUBERCULOSIS That there is a direct relation between a renal and a genital tuberculosis has already been mentioned The frequency¹⁵

¹³ Handbuch für Urologie, Vol 4, 153, 1926, Julius Springer, Berlin

¹⁴ J A M A, 1922, 79, 2076 (Dec 16)

¹⁵ Kuttner believes renal tuberculosis occurs in forty per cent of cases of genital tuberculosis, Rafin in fifty-three per cent, Suter in seventy per cent and Wildbolz in seventy-one per cent (Walthard)

with which these two localizations occur simultaneously or one follows the other, is of the utmost importance from the clinical standpoint

TUBERCULOSIS OF THE EPIDIDYMISS

PATHOLOGY—MODES OF INVASION OF THE EPIDIDYMISS

(a) **Hematogenous Route** There is always a primary focus elsewhere in the body, most commonly in the lungs, kidneys, bones, joints, etc. In some cases it is not difficult to find such a primary localization, even clinically, but in others it is very difficult, even at autopsy. This hematogenous route is, in our opinion, the only primary mode of invasion of the male genitalia, localizing first in the epididymis. The other male genitalia are always involved secondarily by one of the other routes given next.

(b) **Along the lumen of the vas from the seminal vesicles and prostate** This is termed the intracanalicular route by Walthard and others.

(c) **By way of the lymphatics from tuberculous foci in the inguinal lymph nodes, hip, etc.** This route is very uncommon. The tubercles develop primarily in the interstitial tissue between the tubules in the most common mode of infection,¹⁰ i.e. the hematogenous.

Route of Involvement. As a rule, the first involvement is in the tail in both the hematogenous and intracanalicular (by way of lumen of vas) modes of origin. Caseation (Fig. 279) occurs at an early period with destruction of the tubule and spread of the infection to the periepididymal tissue, including the tunica vaginalis. Not infrequently the epididymis becomes adherent to its scrotal coverings and the contents of the abscess resulting from the caseation are evacuated through the skin. These constantly discharging scrotal sinuses occur more frequently and are more characteristic of tuberculous than of any other form of epididymitis. In some cases, after the abscess cavity (into which more or less of the epididymis has been converted) has completely evacuated its contents, fibrosis or encapsulation of the remaining infected portion may occur.

Isolated primary tuberculous involvement of the testis can occur without an epididymitis but is very rare. Eisenstaedt (loc. cit.) quotes Sussig's report of a case in an eleven weeks old infant in whom the testis was involved. Serial sections of the epididymis failed to reveal the presence of tubercles. A few similar cases are quoted by Eisenstaedt. In addition to reporting one of his own in which there was a diffuse productive tuberculosis of the testis in a three year old child with a normal epididymis.

It is evident that a primary tuberculosis of the testis can occur and that such a localization is most commonly found in infants and young children. As a rule, however, invasion of the testis is secondary to that of the epididymis but occurs at a comparatively late stage (see operative treatment later). According to Marion, the testis remains uninvolved in 80 per cent of the cases of tuberculous epididymis.

Involvement of the tunica vaginalis is also a relatively late condition. Fluid may be found between the layers of the tunica vaginalis in many cases even when no visible involvement of this serous membrane is present. The fluid

¹⁰ In the intracanalicular, i.e. by way of the lumen of the vas mode of infection, the earliest changes are in the epithelial lining of the tubules with later invasion of the interstitial tissue.

in these secondary hydroceles (Fig 278) is usually clear, rarely bloody. At first, the serosa is smooth and shining but later it becomes greatly thickened so that transillumination (see Fig 292) of such a hydrocele, is impossible. In some advanced cases, tubercles can be seen on the serosa, usually on the visceral layer, i e, the one in contact with the testis.

Tuberculosis of the testis may occur in rare instances by the hematogenous route, but it nearly always extends by continuity from the epididymis.

Tuberculosis of the vas deferens also as a rule, occurs secondary to an involvement of the epididymis, seminal vesicles or prostate along the lumen or wall of the vas. Usually tuberculous changes in the vas are most marked in the scrotal portion or in the ampulla, with very little involvement of the intervening intra-abdominal portion. The further away the primary focus is, the less advanced are the changes in the vas. There are two forms of involvement of the vas which are of clinical importance. In one, there is a diffuse thickening. In the other, the tuberculous changes are more circumscribed and form a series of nodules along the course of the vas. Caseation occurs in the wall of the tuberculous vas as elsewhere in the genital tract, leading to sinus formation. Stricture of the vas may occur at any early stage of tuberculous involvement just as it does in the ureter.

CLINICAL PICTURES

Tuberculosis of the epididymis presents itself clinically thus:

1 As an acute condition simulating a nontuberculous acute epididymitis. There is severe pain which may radiate along the vas. Edema and redness of the scrotum, a painful, much enlarged and firm epididymis are associated with general symptoms such as fever, leukocytosis, etc. It will be noted that this picture is in every detail the same as in acute gonorrheal or ordinary pyogenic epididymitis.

A SIMILAR ACUTE ONSET AT TIMES IS OBSERVED IN RENAL TUBERCULOSIS (see Chapter 41) and is as a rule, due to a mixed infection with the ordinary pyogenic organisms. As soon as the symptoms in this acute form of tuberculous epididymitis subside, one can palpate the nodular thickening of the epididymis, usually of the tail at first, rarely of the head. We were consulted by a young man who gave the history of having had such a mode of onset as a complication of an acute gonorrheal urethritis. It was not until three months later, when an abscess evacuated its contents spontaneously through the skin of the scrotum, that one suspected a condition other than gonorrhea. The pus from the epididymis at operation contained both gonococci and tubercle bacilli. A later involvement of the kidney required removal of this organ. The same mixed infection was found here also.

2 As a chronic condition. This is the most common clinical type and the onset is gradual. At first, it is almost painless, the picture being that of a low grade systemic infection of a chronic type. At this time, if attention has been directed to the scrotum by a dull aching pain, one can palpate a hard round smooth nodule in the tail of the epididymis varying in size from that of a bean to that of a filbert. The body of the epididymis is seldom involved in the early stage and the head even less so. At a little later stage the entire epididymis is much enlarged, firm and nodular (Fig 279). There may or not be an accompanying hydrocele.

It is easy on palpation to distinguish the firm enlarged nodular epididymis

from the testis unless a secondary hydrocele (Fig 278) is present or the disease is advanced, or both. In the latter, the epididymis is often found adherent to the scrotum and one or more sinuses from which pus is being constantly discharged, may be visible on the scrotal skin. In the early stages the vas may reveal no alterations but as the changes in the epididymis progress, the scrotal vas becomes either uniformly thickened or one can feel one or more bead like nodules corresponding to tubercles. The urine is often clear in the early stage, but the guinea pig test is often positive (Zuckerlandl). Later in the disease there is moderate pyuria but one should always be suspicious of a concomitant renal tuberculosis, if the pyuria is marked.

DIAGNOSIS

The diagnosis is very easy, if the following are present

(a) A painless firm nodular enlargement of the entire epididymis sharply demarcated from the testis proper, (Fig 278) on one or both sides

(b) A diffuse, not tender thickening or a more nodular (beak like) condition of the scrotal portion of the vas deferens

(c) One or more firm sharply demarcated nodules in the prostate (on rectal examination) and a diffuse often somewhat irregular enlargement of the seminal vesicles.

(d) If there is moderate pyuria and one is fortunate enough to find the tubercle bacilli in smears made from the centrifugized urine¹⁷ or in culture¹⁸ or one obtains positive guinea pig inoculations¹⁹

(e) If there is a history of a preceding renal tuberculosis or a discharging scrotal sinus.

These are the easier cases to recognize. If however, one of the following conditions exists the diagnosis is much more difficult

(a) If a secondary hydrocele¹⁹ accompanies the epididymal condition so that one cannot palpate the epididymis and testis. The same is true of those cases in which the two last named structures are so matted together that one can only feel a diffuse hard mass in the scrotum

(b) If there are no palpable changes in the vas prostate or seminal vesicles.

(c) If there is a history of an acute gonorrheal epididymitis followed by persistence of some of the induration or of a chronic urethritis with a complicating prostatovesiculitis (see Chapter 13) and only one or an absence of nodules in the epididymis

(d) A clear urine or one containing only the ordinary pyogenic organisms and a small amount of pus and the search for tubercle bacilli has been negative.

DIFFERENTIAL DIAGNOSIS

One must take into consideration the following

1 Gonorrheal and ordinary pyogenic epididymitis. A differentiation in the cases of acute tuberculous epididymitis referred to under clinical pictures

¹⁷ See article by Jeck and Munch in J Urol., 1927 18, 607 (Nov)

¹⁸ Hohn, Münch. med. Woch. 73 609 1926 and H. C. Sweeney An. Rev. Tuberc., 1928, 1 47

¹⁹ If the hydrocele (symptomatic or secondary) is so large as to render palpation difficult one is justified in tapping it in order to allow the fluid to escape.

due to a mixed infection, is impossible until the acute symptoms have subsided. At such a period, one should always be suspicious if a diffuse enlargement or a nodule at the tail of the epididymis persists for a number of months. These cases must be kept under observation, smears made from the urine and rectal examination made at intervals, for nodules in the prostate as well as enlargements²⁰ of an

indurative type in the seminal vesicles. The post-gonorrheal epididymal enlargement, and this is equally true of the non-gonorrheal²¹ epididymitis, has as a rule a smooth and not a nodulated surface as does the tuberculous one.

If there is an accompanying hydrocele it may be necessary to allow its contents to escape by trocar and cannula to be able to palpate better. Such a hydrocele (Fig 278) may accompany a number (see below) of other enlargements of the testis and epididymis, than those due to tuberculosis. The vas is also enlarged in epididymitis due to the gonococcus or ordinary pyogenic bacteria.²² The gradual onset and involvement of the epididymis as well as the nodular character of the surface speak for tuberculosis rather than either of the above. Massage of the prostate and vesicles in suspected tuberculous epididymitis, is inadvisable, because of the danger of a miliary tuberculosis as well as of a spread to the periprostatic and perivesicular tissue. The presence of a beaded condition of the vas, of nodules in the prostate, markedly indurated enlargement of the vesicles and finally the presence of scrotal sinuses, all speak for a tuberculous infection. Adhesion of a gonorrheal or ordinary pyogenic epididymitis to the scrotal skin, with formation of a constantly discharging sinus, is very rare.

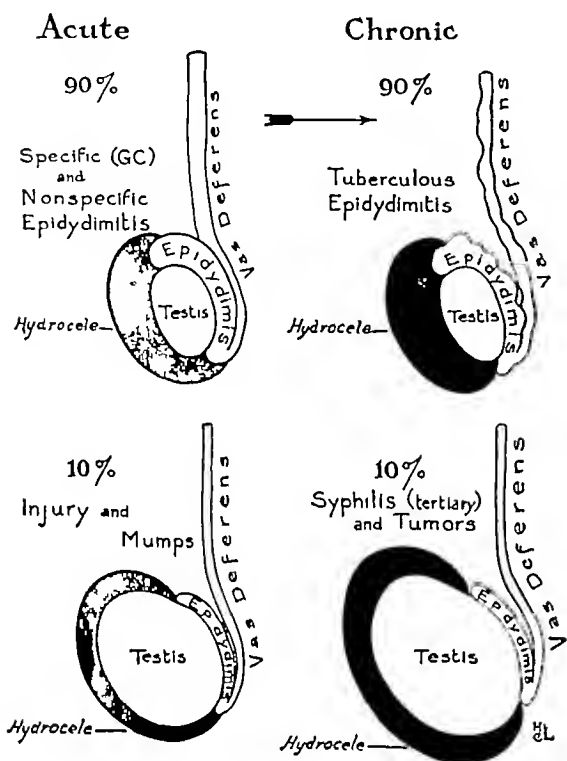


FIG 278—Diagrams of most common enlargements of testis, epididymis and vas and of secondary hydroceles. Cases as seen clinically can as a rule be divided into acute and chronic (see text). 90 per cent of the acute are due to gonorrheal or ordinary pyogenic epididymitis with very little involvement of the testis but often with a secondary hydrocele (symptomatic). 90 per cent of the chronic form are due to tuberculosis. They involve the epididymis and not the testis and frequently are complicated by a symptomatic hydrocele. The remainder (10 per cent) of acute and chronic cases are due to injury and mumps in the acute and to syphilis and neoplasms, in the chronic. In both of these (acute and chronic) remaining 10 per cent of enlargements, it is the testis and not the epididymis which is involved. As in the 90 per cent where the epididymis is chiefly involved, there may or may not be an accompanying secondary hydrocele. Involvement of the vas is discussed in the text.

One encounters cases where every diagnostic resource has been exhausted and only exploratory exposure of the epididymis will clear up the diagnosis, by finding the typical tubercles or areas

²⁰ The normal seminal vesicle is not often palpable.

²¹ Due to ordinary pyogenic organisms (staphylococcus, streptococcus, colon bacillus, etc.), such an epididymitis may be of hematogenous or urethral origin.

²² Due to ordinary pyogenic organisms (staphylococcus, streptococcus, colon bacillus, etc.) such an epididymitis may be of hematogenous or urethral origin.

of localized or more diffuse caseation, on section of the epididymis. At times, microscopic examination of excised portions may be necessary before a diagnosis can be made. In suspicious cases, the presence of tuberculous foci elsewhere in the body (see Etiology) or in the kidney, will be of great aid.

2. From other causes of enlargement of the epididymis and testis. These cases do not present the difficulties, as a rule, which those of the preceding group do, provided that one keeps the following (see Fig. 278), in mind:

(a) OF THE ACUTE ENLARGEMENTS OF THE EPIDIDYMITIS AND TESTIS, NINETY PER CENT AT LEAST CLINICALLY, ARE DUE TO GONORRHEA OR AN ORDINARY PYOGENIC (hematogenous or urethral) INFECTION. Occasionally one will find cases of mixed infection due to one or both of these two groups of bacteria plus the tubercle bacillus (see clinical pictures). All of these acute enlargements involve the epididymis predominantly, and one might almost say exclusively and not at all the body of the testis.

Palpation (Fig. 91) may be rendered difficult because of the frequently accompanying hydrocele (Fig. 278). The other forms of acute enlargements (10 per cent) are due to either injury or to mumps. They involve the testis proper and seldom, if ever, the epididymis so that with the history of the case and the finding of a greatly enlarged tender testis the differentiation from a tuberculous epididymitis ought not to be difficult. Secondary hydrocele is infrequent in both injury and mumps but at times there may be an extensive accumulation of blood in the tunica vaginalis after injury, which may make palpation difficult. Even under these conditions the subcutaneous hemorrhagic infiltration of the scrotum, the history of injury and the inability to obtain translucency are characteristic of traumatic orchitis.

(b) OF THE CHRONIC ENLARGEMENTS (Fig. 278) OF THE TESTIS AND EPIDIDYMITIS WE FIND AGAIN THAT NINETY PER CENT ARE DUE TO ONE DISEASE, *VIZ.*, TUBERCULOSIS. Of course one must bear in mind those rare cases in which a tuberculous epididymitis may begin suddenly or where a gonorrheal or ordinary pyogenic acute epididymitis does not subside and may require differentiation as outlined above.

Of the remaining ten per cent of chronic enlargements, there are only three which need be considered. These are syphilis and neoplasms of the testis and also spermatocele. The last named was considered earlier in this chapter. The other two rarely involve the epididymis primarily. As a rule the testis proper is the seat of enlargement in syphilis as well as in neoplasms. The positive Wassermann reaction, the history of the case and the fact that the enlargement is of the testis proper (Fig. 278), and not of the epididymis, speaks for a gumma of the testis. A neoplasm of the testis (see Chapter 21) should always be suspected if an enlargement of the testis proper (Fig. 278) is present and syphilis can be excluded.

A secondary (symptomatic) hydrocele may accompany syphilis as well as a neoplasm of the testis so that it may be necessary to evacuate the fluid in order to make a differentiation possible.

TREATMENT

Cases of tuberculosis of the epididymis can be divided for purposes of treatment into two groups:

MALE GENITALIA

Those in Which Operative Measures are Still Possible Epididymectomy²³ combined with removal of the scrotal portion of the vas or when the testis is involved, epididymo-orchidectomy²³ are today the methods of treatment, of choice, provided that the following contraindications are not present

(a) **ADVANCED TUBERCULOSIS ELSEWHERE IN THE BODY**, e g , in the lungs, peritoneum, both kidneys, joints, bones, etc In cases of concomitant unilateral renal tuberculosis, the removal of the epididymis is not contraindicated, but should be preferably done at a separate sitting

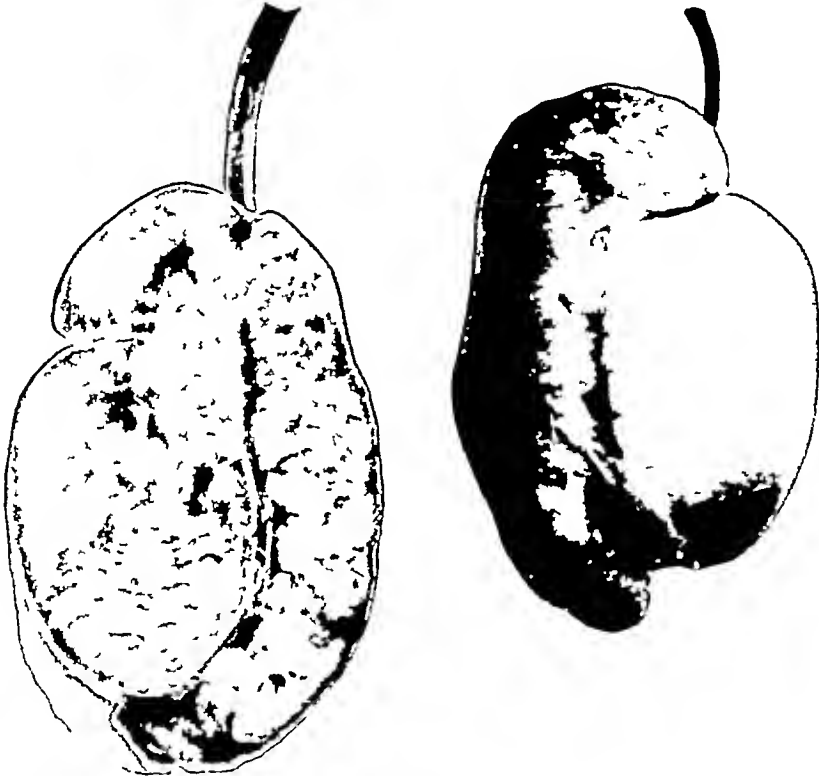


FIG 279—In the left illustration is a specimen of an advanced tuberculosis of the epididymis with beginning extension to the testis, necessitating removal of both epididymis and testis In the right illustration is a specimen in which the tuberculosis is still limited to the epididymis (Courtesy of Dr H Walthard of Berne, Switzerland)

(b) **IF THERE IS AN ADVANCED TUBERCULOSIS OF THE ENTIRE MALE GENITAL TRACT ON BOTH SIDES** The presence of a uni- or even bilateral tuberculous epididymitis without any or only a moderately advanced involvement of the prostate and seminal vesicles, is not a contraindication in our opinion In a relatively large number of such cases the condition of the prostate and seminal vesicles will greatly improve²⁴ if the measures enumerated under the General and Non-operative Treatment, can be carried out In other cases in which either the disease of the prostate and seminal vesicles does not improve or a tuberculous urethral stricture develops, the removal of the prostate and seminal vesicles still offers a prospect of permanent cure Ligation of the vas on the noninvolved side is of little benefit because epididymal tuberculosis is predominantly due to haematogenous infection The removal of the epididymis and vas alone, if performed

²³ See Chapter 50 for technic of epididymectomy and of epididymo-orchidectomy The operations can be carried out on both sides at the same sitting, in bilateral involvement

²⁴ This occurs in from forty-five to sixty-four per cent of the cases after epididymectomy, according to Walthard (loc cit)

early enough permits the testis to be conserved which is of the greatest importance because of its internal secretion. Later tuberculous involvement of such a testis may necessitate a secondary removal. Epididymectomy of course includes excision of all scrotal sinuses and division of the scrotal vas with the cautery as high up as possible.

At The Mayo Clinic of sixty six cases reported by Hunt (*loc. cit.*), bilateral epididymectomy was performed in eighteen unilateral in thirty three bilateral orchidepididymectomy in one, and unilateral in nine cases. Epididymectomy was performed on one side and orchidepididymectomy on the other in five.

There was a persisting sinus in only one of forty nine cases (71 per cent) which could be followed up. In cases in which there was unilateral epididymitis at the time of operation the opposite epididymis remained free from infection for from one to five years except in two in which later removal of the corresponding testis was necessary. Eighty five and five tenths per cent of the forty nine cases (71 per cent of the 66) are well or markedly improved. Our own experience agrees with those of The Mayo Clinic Wildbolz Young and others that operative measures in tuberculous epididymitis are followed by more rapid and better results than nonoperative measures.

2. Conditions under which Nonoperative Measures are Indicated or are the Method of Choice. The treatment under this heading includes the following:

(a) GENERAL. These include those usually employed in the treatment of tuberculosis elsewhere in the body such as rest, fresh air, a dry sunny climate and good food. In addition the following can be employed:

(b) HELIOTHERAPY AND RADIOTHERAPY. Both of these nonoperative measures have had their supporters. Radiotherapy causes encapsulation but this is accompanied by atrophy of the seminiferous tubules of the testis (Waltherd). The cases treated by radiotherapy which have been reported as cured have not been controlled microscopically, so that a mistake in diagnosis is easily possible.

Heliotherapy which has been extensively employed in Switzerland is condemned by Wildbolz. Of thirteen epididymes removed at operation by him after heliotherapy of eight months to seven years duration the symptoms had improved, but there was no change on microscopic examination except in three where there was marked encapsulation of the focus.

(c) Tuberculin in the opinion of one of us (Rolnick) has a definite place in the pre- and postoperative treatment of genital tuberculosis. Tuberculin residue (T.R.) is the best preparation to employ. It can be given at first in the dosage of 0.01 mg. gradually increasing the dosage.

TUBERCULOSIS OF THE SEMINAL VESICLES

The most common mode of invasion is along the lumen, i.e. intracanalicular from the epididymis or the ejaculatory duct (urethra). Lymphogenous and hematogenous modes of infection are very rare.

PATHOLOGY

The pathologic changes closely resemble those already described under tuberculous epididymitis. If the infection is carried by the blood vessels the tubercles first form in the interstitial tissue between the divisions or compartments (Fig. 61).

If the infection occurs by way of the lumen, there are at first catarrhal changes in the epithelial lining, the vesicle being filled with pus containing desquamated epithelium, sperm, and tubercle bacilli. Later, the wall is involved, with tubercle formation and inflammatory infiltration so that the contents become more caseous. There is much more of a tendency on the part of both the tuberculous prostate and seminal vesicles towards connective tissue proliferation than is true of tuberculous epididymitis (Fig 279), so that extensive perivesiculitis is common. Fistulae may develop and open into the rectum, perineum or rarely into the bladder.

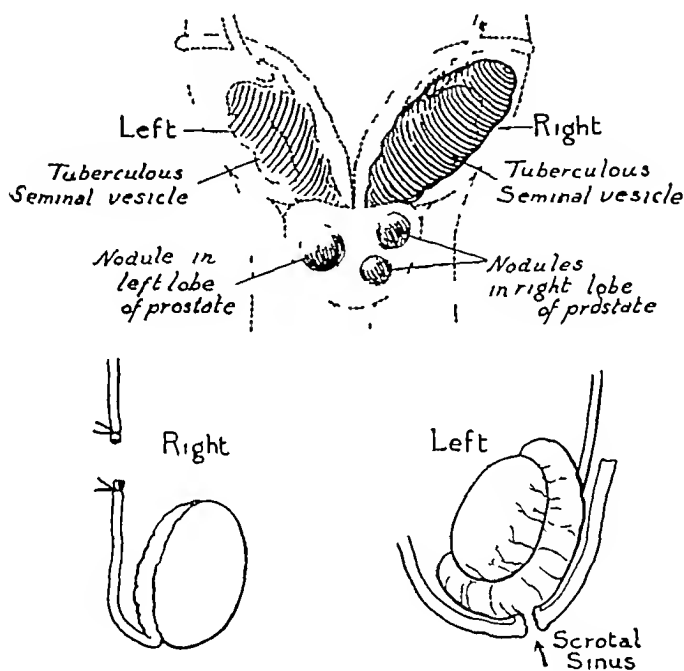


FIG 280—Diagram from one of our cases of tuberculosis of the male genital tract. The rubber stamp employed to record findings in such cases was first suggested by Dr. Hugh H. Young. The patient had a left renal and left epididymal tuberculosis. The latter had perforated skin of scrotum. Ligation of right vas deferens failed to check involvement of right epididymis because of hematogenous infection of latter. Note extensive involvement of prostate and vesicles.

SYMPTOMS

There is an absence of any symptoms which are of any value from a diagnostic viewpoint. A dull aching sensation with pain radiating to the perineum and possibly hemospermia, are present in many cases. If the entire vesicle is involved, it can be felt as a sausage-like, (Fig 280) firm or soft (if caseation has occurred) elevation, through the anterior rectal wall. At times, the tuberculous involvement is most marked at the neck (Fig 50) and one can feel a nodular cordlike mass just above the base of the prostate. In other cases the tip alone is involved at first, according to Wildbolz. The diagnosis is only difficult in cases of primary involvement of the vesicle and such cases are very rare. If, however, there are nodules in the prostate or epididymis or both, or there is a concomitant renal tuberculosis, the differentiation from other causes of vesiculitis, is not difficult. One should never attempt to massage the vesicle or prostate if there is a suspicion of tuberculous involvement.

The treatment of tuberculous seminal vesiculitis will be considered later.

TUBERCULOSIS OF THE PROSTATE

That a primary localization in this structure is very rare is shown by the recent study made by Bothe²² in connection with the report of a case in which tuberculosis was found during routine microscopic study of specimens of prostatic hypertrophy,²³ removed at operation. A survey made by Bothe of the reported nine cases of apparently primary tuberculosis of the prostate revealed the fact that an autopsy was only made in four cases. In three of the nine the tuberculosis was found in specimens of prostatic hypertrophy removed at operation. That the prostate is however, frequently the seat of a secondary infection (by way of its ducts) is shown by the fact that in 1760 cases of genitourinary tuberculosis



FIG. 281.—Specimen showing advanced tuberculosis of the prostate. Note all stages from miliary nodules to large areas of caseation.

collected by Walthard it was present in 809 or sixty three per cent. In addition to the most frequent mode of invasion by way of the ducts the prostate is also infected at times by contiguity for example from a tuberculous seminal vesicle.

The pathological changes (Fig. 281) in the early stages are quite analogous to those in the intracanalicular (by way of the lumen) mode of invasion of the vesicle or epididymis. Later tubercles form in the tissue between the acini and may coalesce to form a large conglomerate tubercle varying in size from a lentil to that of a hazelnut. Diffuse involvement of the entire gland is rare. Caseation

²² Jour Urol., 1927 18, 494 (November)

²³ This has already been referred to in Chapter 18

occurs relatively early and the abscess may be evacuated spontaneously (Fig 204) into the urethra or through the perineum or rectum, rarely into the bladder. In a few cases, encapsulation occurs, so that one feels a firm irregular nodulated mass, on rectal examination. Wildbolz believes such an apparent healing is deceptive and virulent bacilli remain, so that recrudescence can occur at any time. There is, as in the case of the seminal vesicle, always more or less involvement of the periprostatic tissues and sinuses can develop which burrow into the perivesical and perirectal cellular tissue, even as high as the space of Retzius (Fig 51).

SYMPTOMS AND DIAGNOSIS

In over two-thirds of the cases there is an absence of symptoms referable to the prostate, according to Marion. In its early stages it may simulate a chronic prostatitis of nontuberculous origin. Walthard (*loc cit*) distinguishes two clinical pictures under which prostatic tuberculosis appears.

1 Urethrovesical symptoms, such as slight tenesmus, frequency, pain at the end of urination and a feeling of weight or pressure referred to the perineum. Usually there is a slight serous, later purulent or bloody urethral discharge.

2 Rectal symptoms, such as tenesmus, pain on defecation and few, if any, of the symptoms of the urethrovesical group.

In later cases, one cannot distinguish the symptoms of a tuberculous prostatitis, from those of a similar infection of the vesicles, bladder and urethra. Ejaculation is often painful and hemospermia can exist without seminal vesicle involvement.

On rectal examination, one finds an enlarged and firm prostate in the early stage. Later, the typical small or large irregularly distributed nodules appear. At times, there are more nodules in one lobe than in the other (Fig 280). As a rule, there is not much protrusion of the prostate into the rectum, but occasionally, if there is a large cavity in the prostate filled with pus, the protrusion is quite marked.

The differentiation of a tuberculous prostate from other forms of chronic prostatic enlargement, has been considered under diagnosis of prostatic hypertrophy in Chapter 18. The diagnosis of the presence of a tuberculous prostate is usually made during rectal examination, in cases where there is similar infection of the epididymis or when marked vesical symptoms, which are evidently not of renal origin, are present in a case of tuberculosis of the kidney.

TREATMENT OF TUBERCULOSIS OF THE SEMINAL VESICLES AND PROSTATE

Inasmuch as most of the cases are secondary to a tuberculosis of the epididymis, the question arises as to whether or not to follow up the removal of this primary focus by the more serious operation of prostatectomy and seminal vesiculectomy. It has been the experience of the majority of those who have followed up a large series of cases, that as a rule the foci in the prostate and seminal vesicles will greatly improve and in some, even heal, if the epididymal or renal primary focus has been eliminated at an early stage.

However, when the involvement of the prostate and vesicles is marked simple epididymectomy will be of little value in abating the process. In the advanced case there is often an abscess of the seminal vesicle due to superimposed secondary infection which will be aided materially by perineal drainage. Just as nephrectomy

for tuberculosis will frequently not cause the improvement of the advanced bladder tuberculosis so epididymectomy will not cure the advanced tuberculosis of the seminal vesicle and prostate. It is in these advanced cases that Young's Radical Operation for Tuberculosis of the seminal tract (Fig 282) is indicated. This operation consists of the removal of the entire seminal tract the prostate and vesicles perineally and also the epididymis and vas. We have done ten of these operations. There has been no mortality. They have all recovered and appear



FIG. 282.—Operative specimen showing radical removal of tuberculosis of entire seminal tract. Lc of the epididymis, vas deferens, prostate and seminal vesicles.

markedly improved following this radical procedure. The majority of these ten patients were kept under observation by us over a period of two to three years.

CHAPTER 21

TESTIS AND SCROTUM

ANOMALIES OF THE TESTIS	HYDROCELE AND HEMATOCELE
ANOMALIES IN SIZE	HYDROCELE
ANOMALIES IN POSITION	HEMATOCELE
TREATMENT IN CRYPTORCHIDISM	CHYLOCELE
INJURIES OF THE TESTIS	NEOPLASMS OF THE TESTIS
ATROPHY OF THE TESTIS	PATHOLOGY
INFECTIONS OF THE TESTIS	SYMPTOMS AND DIAGNOSIS
	TREATMENT
	THE SCROTUM

ANOMALIES OF THE TESTIS

These are divided into

- 1 Anomalies in number and size
- 2 Anomalies in position

We will consider the above in the order named

ANOMALIES IN NUMBER AND SIZE

Anorchism or Absence of the Testis This is rare and of little clinical interest, only 34 cases having been reported according to Campbell (Pediatric Urology 1936, 1, 363) This anomaly may involve absence of the testis alone, absence of the testis, epididymis and a portion of the vas deferens and finally, absence of the entire spermatic tract

Synorchism or fusion of both testes within the abdomen or scrotum Six cases have been reported

Polyorchism or Supernumerary Testis This is also a rare anomaly According to Boggon (Brit Jour Surg 1933, 20, 630) only 12 histologically proven human cases have been reported Jordan and Dodson (Jour Urol 1934, 32, 311) added a thirteenth case in the human The anomaly was found on the left side in ten of the thirteen human cases

Lack of Development of the Testis Aside from the lack of development so commonly found in association with anomalies in position, the same condition is observed in the normally descended testis, in the absence of a history of infection or injury Such congenitally small testes are often found in cases of endocrine dysfunction especially in hypogenitalism as described under anomalies in position of the testis

ANOMALIES IN POSITION

Up to the last months of intrauterine life, as explained in Chapter 1 on Embryology, the testis lies extraperitoneally in the iliac fossa (Fig 7) and close to the internal ring From this location it passes through the inguinal canal and under normal conditions reaches the lower end of the scrotum, where it is found at birth

There still exists some difference of opinion as to the underlying factors involved in the descent of the testis We will enumerate the principal theories as to the causes of this change in position of the testis from its original intra-

abdominal to the final (under normal condition) location in the scrotum in the human race

1 The role of the gonadotropic hormone of the pituitary

The importance of this factor has only been appreciated since Schapiro (Deut. Med. Woch., 1930 56 1650) reported remarkable results obtained in using the gonadotropic hormone found by Zondek in the urine of pregnancy, in cases of cryptorchidism. Since then there exists much corroborative evidence of hormonal influence on the growth and descent of the testis in animal experiments. The hormonal treatment of cryptorchidism so extensively employed at present to be referred to later is based on this action of a gonadotropic hormone on the descent and development of the testis.

We have placed this hormonal factor as the first of the causes of the normal descent of the testis because we believe it explains such a phenomenon better than any other of the long list of causes cited in the past.

To sum up under normal conditions, the gonadotropic hormone of the anterior lobe of the pituitary during fetal life is the most important factor in our opinion in the migration of the testis in the human race from an intra to an extraabdominal position. Under the next heading role of the gubernaculum it will be seen that such a migration instead of taking place into the scrotum may undergo a deviation into an extra-scrotal location. The pituitary hormone not only has an influence on the migration of the testis but also on its development.

When pituitary dysfunction exists the following anomalies may occur

- (a) The testis remains within the abdomen but is well-developed
- (b) The testis is in the scrotum but fails to develop and is accompanied by other symptoms of endocrine dysfunction (see Hypogonitalism)

2 Role of the Gubernaculum.

The older theory has been abandoned that this structure exerts traction on the testis and is hence one of the chief factors in the migration of the testis. The gubernaculum is chiefly composed of fibrous and elastic tissue with a few poorly developed muscular fibers. That it does not play any part in the descent of the testis is shown by the fact that the testes are found in the scrotum at a time when muscle fibers cannot be demonstrated in the gubernaculum. One cannot deny that the gubernaculum plays a part in the determination of whether the testis is directed toward the scrotum or on the other hand toward the pubic femoral or perineal regions. These aberrations or deviations from the normal position of the testis in the scrotum to abnormal locations are the result of the fact that the gubernaculum has a four-tailed distal insertion as shown in Fig. 283.

THESE GUBERNACULUM INSERTIONS ARE

- (a) To the lower end of the interior of the scrotal fascia (Dartos scroti)
- (b) To the pubic bones
- (c) To the tissues over Scarpa's triangle (femoral)
- (d) To the perineal tissues

Of these the scrotal attachment is most developed.

As will be seen later under Treatment it is essential constantly to keep in mind that the testis may be arrested not only in the change of position from the

abdomen to its normal position in the scrotum, but that it is futile to attempt organotherapy when

- A The testis is in an aberrant position
- B When certain mechanical factors are present to prevent descent
- C When certain complications exist (see below)

We will consider these in the above order

A The Testis in an Aberrant Position The testis in its migration from the early fetal position (Fig 7) to the lowermost portion of the scrotum may be either "arrested" in its course or may be directed, probably through action of the gubernaculum (Fig 283) away from its normal course. Hence it is convenient, clinically, to place cases into two groups, as follows

1 **CASES OF ARRESTED DESCENT**, are divided thus (a) Abdominal, i.e., within abdominal cavity (extraperitoneal, usually close to internal ring (A of Fig 283 A), (b) inguinal, i.e., found at operation in inguinal canal between internal and external rings (B of Fig 283 A) or between the external oblique aponeurosis

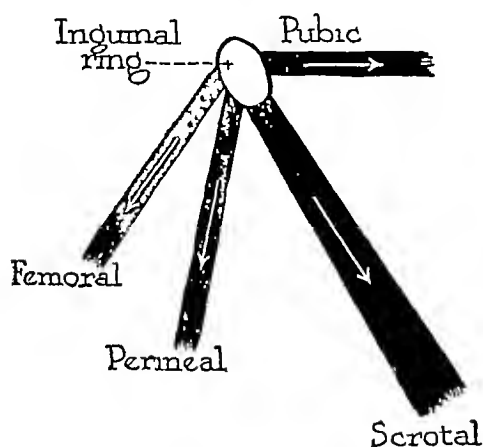


FIG 283—Diagrammatic representation of the four attachments of the gubernaculum testis. Arrows point toward scrotum (bottom of), pubic, femoral, and perineal regions respectively (See text)

and skin of inguinal region. In many of these the testis lies in the canal, but slips back readily into the abdominal cavity, (c) just distal to the external ring (C of Fig 283 A). It would seem only just, to include under arrested descent, all cases in which the testis is found beyond the external ring, but cannot be brought down into the scrotum.

2 **ABERRANT OR FAULTY DESCENT** This term is applied to those cases in which the migration or "descent" of the testis is not arrested in its normal course (abdominal, inguinal, upper scrotal, A, B and C of Fig 283 A), but the testis wanders or is caused to deviate from the route which it would ordinarily follow toward the lower

end of the scrotum, into "aberrant or faulty" paths, viz., to the pubes, Scarpa's triangle or perineum (D, E and F of Fig 283 A). When we recall these other three attachments of the gubernaculum (Fig 283), it is not difficult to visualize how the testis is directed away from its normal course (toward the scrotum) into one of these aberrant routes. These are

- (a) The pubic, in which the testis is found above the symphysis pubis (D of Fig 283 A)
- (b) The femoral, in which the testis is found over Scarpa's triangle (D of Fig 283 A)
- (c) The perineal, in which the testis is found either in the perineal region proper or lateral and external to the scrotum (F of Fig 283 A and Fig 294)

B Action of Mechanical Factors in Arrested Descent

The following mechanical factors may prevent the testis from descending into the scrotum

1 **ADHESIONS** as the result of a fetal peritonitis. This is Budinger's theory but has received but little support

2 **SHORT SPERMATIC VESSELS OR VAS OR BOTH** The existence of these factors cannot be denied. They undoubtedly play an important part in preventing complete descent of the testis.

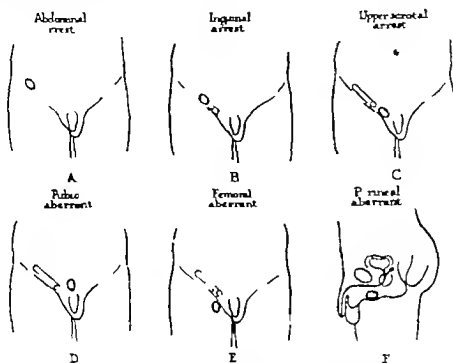


FIG. 283A.—Diagrams of the locations at which the testis can be arrested in its descent toward bottom of scrotum and at which it may be turned aside from its normal course.

3 **FAULTY DEVELOPMENT OF THE MUSCLES** of the inguinal canal associated with powerful action of the cremaster muscle



FIG. 284.—Perineal testis (Eccles) Courtesy W. B. Saunders Co.

Under normal conditions the internal oblique muscle and conjoint tendon of this muscle and of the transversalis muscle act as a sphincter to prevent the return of the testis during the latter months of intrauterine life into the abdomen.

The cremaster muscle completely envelops the coverings of the testis and spermatic cord. When this latter muscle contracts it pulls the testis toward the external inguinal ring and if there is no resistance into the inguinal canal or, if the latter is large, into the abdomen. If the sphincteric action of the internal oblique muscle and conjoined tendon is faulty as the result of a congenital lack of development, the more powerful cremaster muscle will constantly pull the fully descended testis into the inguinal canal. Some of the poor results following organotherapy are no doubt due to failure to appreciate these mechanical factors, especially the last named action of the cremaster in the presence of insufficiently developed abdominal muscles.

MIGRATING TESTIS We have applied the term "migrating" testis to these cases in which the testis is found at the bottom of the scrotum at one examination and in the inguinal canal or even abdomen a few minutes later. This condition of "migrating" testis is a very common finding in infants, who can pull the testes

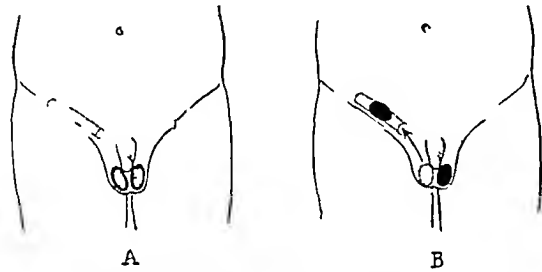


FIG 285 —Diagrams of change in position of migrating or abnormally movable testis (uni- or bilateral)

A Both testes in scrotum and can be held there by examiner. B One testis (right) has slipped up into the inguinal canal (in direction of arrow) and corresponding half of scrotum is empty. Former location of testis represented by dotted oval.

well up into the inguinal canals or even abdomen, when they cry, or push them out when they strain. Toward puberty, such an ability of the testes to wander up and down becomes, as we shall see shortly of considerable clinical importance and is as much of an indication for operation as an arrested or aberrant descent would be. Infants should be watched, because we believe that this constant upward and downward migration of the testes, if it does not cease spontaneously toward puberty, will have an influence on the development of the germinal cells. In his experimental

work, Moore (Amer Jour Obst and Gyn 1935, 28, 1) called attention to the thermostatic function of the scrotum. If the testis lies in the inguinal canal or in the abdomen, the germinal cells take on an irregular appearance, but when it is replaced in the scrotum, the germinal cells are rearranged and the animals became fertile again.

C The Existence of Complications 1 **Hernia** This is an accompaniment of arrested descent of the testis in a large percentage of cases. It is usually of the indirect inguinal variety, complicated in some cases by a sliding hernia of the cecum or sigmoid.

In a small percentage of cases, the hernial sac is of the interstitial variety (Fig 286).

There are three varieties of interstitial hernia which may accompany arrested descent of the testis: (a) the subcutaneous (A of Fig 286 and also Fig 287), (b) the interparietal, where the sac, and often the testis (B of Fig 286) extend upward between the internal and external oblique muscles, and (c) the properitoneal form, in which the sac, and usually the testis, are found between the transversalis fascia and the peritoneum, i.e., in the subperitoneal areolar tissue (C of Fig 286).

2 LACK OF DEVELOPMENT OF THE TESTIS According to Ufreduzzi and other investigators an absence of spermatogenesis is found in about ninety per cent of the cases in which complete descent has not occurred at the age of puberty. The

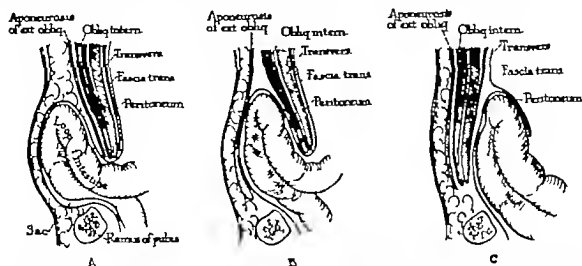


FIG. 286.—Varieties of interstitial hernia which may complicate arrest of the testis. A. Subcutaneous, in which sac and testis are between skin of inguinal region and external oblique aponeurosis. Instead of a simple sac such as this there may be an hour-glass variety with extension toward or into the scrotum. B. Interparietal form with sac between external and internal oblique muscles. C. Properitoneal form with sac between peritoneum and transversalis fascia.



FIG. 28.—Subcutaneous form of interstitial hernia associated with non-descent of the testis (author's case). Note hour-glass form of the sac, the testis lying in the lower half. Its position indicated by the dotted line.

atrophy involves chiefly the spermatogenic cells, and only comparatively rarely the interstitial cells of Leydig. In the majority of cases of successful orchidopexy the testis develops rapidly to normal size if the atrophy is not too advanced at

the time of operation and the latter has been performed early enough to permit further development to occur

3 PRIMARY TESTICULAR NEOPLASMS According to Hinman and Benteen (Jour Urol 1936, 35, 378) who have reviewed the subject, primary testicular neoplasms occur more frequently in cryptorchids than in noncryptorchids. About two per cent of the patients with undescended testis develop neoplasms as compared to an incidence of 0.09 per cent in descended testes. The incidence of primary neoplasms arising in cryptorchids varies from 11 to 15 per cent according to various authors. Hinman and Benteen (loc cit) observed three testicular neoplasms or 2 per cent of 155 cryptorchids.

4 HYPOGENITALISM This syndrome, which is quite often seen in cases of arrested, aberrant, and migrating testes, is one which has not received the attention which its importance merits.

The chief characteristics of the two types of hypogenitalism are

TYPE 1 PREDOMINANCE OF SKELETAL CHANGES The outstanding feature is the unusual length of the upper and lower limbs, as compared to that of the body.

TYPE 2 THE ADIPOSE TYPE, in which fat deposits are predominant.

Symptoms which are common to both types and may be present to a variable degree in both, are the following:

(a) Lack of development of the external genitalia.

(b) Dystrichosis, i.e., absence of hair on the face, thorax, pubes and extremities.

(c) Psychic disturbances.

It will be seen that these changes are closely related to those observed in disease of the pituitary body, viz., in anterior-lobe lesions. In the latter, we have overgrowth of the long bones before the epiphyses are closed. In tumors of the posterior lobe of the pituitary, we observe symptoms of intracranial pressure, as well as the syndrome first described by Froelich in 1901, and termed "dystrophia adiposogenitalis," whose characteristics are identical with those of the adipose type of hypogenitalism.

Primary hypogenitalism is due to deficiency or absence of the hormone secreted by the anterior lobe of the pituitary. The interstitial cells suffer less seriously than do the spermatogenic cells in cases of arrested, aberrant, or migratory cases of undescended testis. They do not develop as they should under normal conditions, with resultant ill-effects upon the evolution of secondary sex characteristics. The chief difference between primary hypogenitalism and lack of development of the testis as the result of nondescent, is the absence of evidence of pituitary disease in the former. Why symptoms of hypogenitalism develop in some cases of cryptorchidism and not in others, is not yet understood. The lesson to be learned, however, is not to delay operative intervention too long in cases of arrested, aberrant and migrating testes.

5 STRANGULATION OF UNDESCENDED TESTIS This is a comparatively rare complication, but it is well to bear it in mind if symptoms like those of a strangulated hernia appear and the scrotum is found empty on the corresponding side.

Bragadse (Zeit Urol Chir 1933, 36, 301) reported two cases, one in a patient 17 years old and another in a baby of 10 months. In the former, there was a strangulation (without torsion of the cord) of the undescended testis in the inguinal canal. In the second patient, the testis was also strangulated but its removal was necessary because of gangrene.

In a case reported by Woodruff and Milbert (*Jour Urol* 1936 36 559) the strangulation was due to a loop of omentum extending into a hernial sac, encircling the undescended testis at its base.

TREATMENT OF CRYPTORCHIDISM

Endocrine Therapy

Schapiro (*Deut. Med. Woch* 1930 II, 1605) was the first to report excellent results in the treatment of two cases of cryptorchidism following the use of anterior lobe pituitary extract. Since that time a large number of reports of the use of either the gonadotropic hormone of the anterior lobe of the pituitary termed antuitrin or the gonadotropic hormone in the urine during pregnancy have appeared.

Young (*Monograph on Genital abnormalities, etc.* 1937) collected reports of 307 cases in whom 407 testes were undescended. The average age varied from 5 to 20 years. The condition was bilateral in 122 and unilateral in 121. In 96 cases, the testis was in the inguinal canal or immediately below it and in 77 cases within the abdomen. The undescended testes descended more or less fully into the scrotum 273 times but failed to do so 157 times. The percentage of success varied from 14 to 100 per cent.

Those with a relatively large experience believe that success is obtainable in at least 50 per cent of the cases. The percentage of success is higher in patients who have not passed puberty.

Dahl Iversen and Starup (*Hospitalstudende* 1937, 80 657) collected 208 cases. Complete descent was obtained in 129 or 62 per cent, partial descent in 25 or 12 per cent and failure resulted in 54 or 26 per cent. In the last named group patients between 20-30 years of age are included. Bilateral cases reacted better than unilateral.

Test for Suitability. A good test as to whether endocrine therapy is likely to be successful or not is the determination of the gonadotropic hormone in the urine in cases of cryptorchidism. Hess, Kunstadter and Saphir (*Jour. Amer. Med. Ass'n* 1937 108 352) found that the outlook for success is good if the gonadotropic hormone is present in the urine and the mechanical factors mentioned above are absent. Absence of the gonadotropic hormone may occur in bilateral cases if the testes are functionally active even if not descended or if there is a primary pituitary dysfunction. Endocrine therapy should be given a trial according to the authors even when the gonadotropic hormone is absent in the urine in both of the above cited exceptions. In unilateral cases absence of the gonadotropic hormone in the urine may be due to adequate function of the fully descended opposite testis.

From a study of seventy-one boys with ninety-one undescended testicles who were given injections of the gonadotropic principle of the urine of pregnant women and the gonadotropic principle of the anterior lobe of the pituitary gland, Bigler and his co-workers (*Amer. Jour. Dis. Child.* 1938 55 273) find that these extracts produce changes in the external genitalia of some patients but not in all. The changes when present are manifested by flushing of the genitalia, enlargement of the testicles and penis or descent of the testicles. In the patients treated with the gonadotropic principle of the urine of pregnant women 48 per cent of the undescended testicles completely descended into the scrotum by the end of

treatment but only 45 per cent remained descended. If the partially descended testicles are included, 61 per cent can be considered benefited. In the patients treated with the gonadotropic principle of the anterior lobe of the pituitary gland 25 per cent of the testicles completely descended into the scrotum but only 18 per cent remained descended. Including those in whom the testicles partially descended, 35 per cent were benefited. When both gonadotropic extracts were used in treating the patient, 40 per cent of the cryptorchid testicles showed complete descent but only 25 per cent of the testicles remained in the scrotum, 55 per cent were benefited. When descent of the testicle occurs, it usually begins to take place before 4,000 rat units of the gonadotropic principle has been administered. Treatment seems to be about equally successful at any age after the first year, but it seems better not to begin treatment until after the seventh year of life. In a control series of fourteen untreated and inadequately treated patients (seventeen undescended testicles) descent of the testicles did not occur. Both extracts often caused enlargement of small testicles but never permanent enlargement of normal testicles. Both extracts produced enlargement of a normal-sized penis in eight boys. Reactions both general and local may occur during treatment. Treatment had no effect on weight or height or on body build, even when hypoplasia of the genitalia was present, with a feminine type of body build. If improvement does not occur by the time about 4,000 rat units of the gonadotropic factor of the urine of pregnant women has been administered, operation may be considered.

The Contraindications to Endocrine Therapy are

- 1 The co-existence of a hernia or hydrocele
- 2 Mechanical obstacles which prevent the descent
- 3 When a testis is of the migrating type as previously described
- 4 When the testis is in an aberrant position, i.e. is found at the root of the penis or in the femoral region (Scarpa's triangle) or in the perineum (see Figs 283 A and 284)

In evaluating the results of endocrine therapy, the fact that the testis will often descend spontaneously at puberty must not be forgotten. Endocrine therapy should be given a six months' trial whenever circumstances permit. If at the end of such a period, descent has not occurred, orchidopexy is to be advised, especially in bilateral cases because of the danger of sterility. The outlook for success following endocrine therapy is very poor after puberty.

Operative Treatment

The earlier an operation is performed, the less the danger of an arrest of development of the germinal cells of the nondescended testis. We have made it a practice to advise operation as early as the fifth year in all cases in which endocrine therapy has failed after a six months' treatment and the testis cannot be brought down further by traction, than the upper part of the scrotum. The chief obstacle to spontaneous descent as observed at operation is the presence of many fibrous bands binding the vas and its vessels (see Chapter L) to the adjacent structures.

The indications for orchidopexy are

- 1 Cases of aberrant descent of the testis, i.e. when the latter is found in the pubic, femoral or perineal regions
- 2 Cases of nondescent with accompanying hernia or hydrocele
- 3 Cases of so-called migrating testis. There is little hope for the testis to become fixed in the scrotum as long as the cremaster can pull it up into the

inguinal canal because of a large external ring and faulty development of the muscles forming the posterior wall of the inguinal canal

INJURIES OF THE TESTES

These organs are fairly well protected against injury because of their mobility and relatively deep location. Blows or other forms of extensive trauma applied over the scrotum give rise to excruciating pain, nausea and a variable degree of shock, all of which are as a rule of short duration. Such injuries may be followed by considerable swelling of the scrotum and may be complicated by the exudation of serum or blood (Fig. 288) into the tunica vaginalis, i.e. give rise to a traumatic hydrocele or hematocele (Fig. 289). Crushing injuries and laceration of the scrotum are not infrequently seen and may cause considerable bloody effusion, resulting in a large hematoma with marked discoloration which persists for many days. The testicle is rarely involved in such injuries. These wounds frequently become



FIG. 288.—Enormous hematoma of scrotum following penetrating injury

secondarily infected. Careful hemostasis is always necessary in scrotal operations for hematoma may follow with secondary infection later. This prolongs the convalescence of the patient over many weeks.

Gunshot and high explosive shell wounds of the scrotum may cause extensive laceration of the skin and testis, often necessitating its removal.

During the World War, extensive burns of the scrotum were often observed following the use of gases containing very irritating chemicals like mustard gas.

ATROPHY OF THE TESTICLE

Under this heading we only include a decrease in size following injury or infection of the testis. The small testis found in cases of endocrine dysfunction such as hypogonadism or in arrested descent of the testis has been wrongly termed an atrophy. The cause of the decreased size of the testis is a lack of development or hypoplasia and not a shrinkage secondary to trauma or infection. A true atrophy of the testis is found under the following conditions.

(a) After mumps. This is the most common cause of atrophy.

- (b) After herniotomy as the result of interference with the blood supply
- (c) Following trauma Here the tissue reaction incident to the trauma is followed by cicatricial atrophy
- (d) A large varicocele may be accompanied by an atrophy of the testis or such an atrophy may be a sequel of an operation for varicocele
- (e) Atrophy may follow recurrent torsion of the spermatic cord
- (f) Thrombophlebitis of the pampiniform plexus is a cause of atrophy of the testis
- (g) Systemic infections, other than mumps, may give rise to a hematogenous epididymo-orchitis followed by atrophy

INFECTIONS OF THE TESTIS ORCHITIS

These may be the result of a systemic infection or of extension from an adjacent focus of suppuration. One sees all degrees of inflammatory reaction from slight interstitial round-celled infiltration to widespread interstitial and tubular changes. In moderately severe infections, small pus foci are visible in the intertubular tissue. These minute abscesses may coalesce to form larger ones or the entire parenchyma may be the seat of a large abscess.

Infection may be primary in the testis and extend to the epididymis or the reverse.

Acute Orchitis This is most commonly secondary to some systemic infection, such as mumps, typhoid, influenza, glanders, undulant fever or of a bacteremia whose primary focus is an osteomyelitis, or other form of localized suppuration. Of all these causes of acute orchitis of hematogenous origin, mumps (parotitis) is the most frequent.

ACUTE ORCHITIS SECONDARY TO MUMPS The virus of this type of infection appears to have a selective localization in the testis. We recall cases in which the orchitis was apparently the chief condition which attracted the patient's attention. In a large series of mumps cases during the World War, we noted an incidence of one orchitis to eight cases of mumps.

With the onset of the orchitis, there is a marked rise of temperature, pain and swelling. Suppuration is rare, but an unfortunate sequel is atrophy of the testis, which takes place in about one third of the cases. A mumps orchitis varies in duration from a few days to as many weeks.

Abscess of the Testis Minute multiple well encapsulated pus foci are a frequent sequel of orchitis of hematogenous origin. Larger abscesses are frequently observed in tuberculous orchitis, resulting in sinus formation. Another cause of abscess formation in the testis, other than systemic infection by nontuberculous and tuberculous bacteria, is a septic thrombosis of the spermatic veins. This is the so-called central abscess of the testicle. Syphilis may produce necrosis of the entire testis. Not every scrotal sinus is indicative of a tuberculous infection of the epididymis or testis or both. Sinus formation is not rare in an acute epididymitis or orchitis due to the ordinary pyogenic bacteria, especially those of the *B. coli* group. The destruction of the epididymis and testis in nontuberculous infection may be so extensive as to necessitate the removal of both epididymis and testis. Such infections occasionally develop in association with bladder neck or urethral obstruction.

Chronic Orchitis The majority of cases diagnosed as chronic orchitis are in reality chronic epididymitis or periorchitis. Inasmuch as the most common cause of chronic orchitis is syphilis we will discuss this separately.

Syphilis of the testis. This localization ranks immediately after that of the cardiovascular and nervous system, as to frequency.

ACUTE SYPHILITIC ORCHITIS This may occur during early syphilis and is an interstitial orchitis. When acute hydrocele (Fig. 278) of one side develops within the first year or two after the onset of syphilis a syphilitic hydrocele should be thought of.



FIG. 280.—Operative specimen showing large hematoma. Note how cavity of tunica vaginalis testis is distended by the hematoma, compressing testis (seen in upper portion of photograph). Note greatly thickened wall of tunica vaginalis (Periorchitis).

CHRONIC SYPHILITIC ORCHITIS This always takes place during the tertiary stage of the disease and presents itself in two forms, an interstitial and a gummatous. Involvement of the epididymis, vas deferens and even of the tunica vaginalis (secondary hydrocele) is common. If resolution does not take place following treatment, there may be extensive breaking down of tissue especially in the gummatous form.

(a) **Interstitial syphilitic orchitis.** This is the most common form, is of slow onset and gradual evolution. The testicle becomes two or three times larger than normal, painless, smooth and very hard. Sclerosis ensues, the condition remaining stationary for a long time and the testicle either returns to normal size or becomes atrophic.

(b) **Gumma of the testicle.** This may be preceded by the interstitial type of inflammation although it is frequently gummatous from the beginning. The enlargement is not diffuse. Distinct nodules, tumors and areas of hardness appear. These may sometimes break down.

The diagnosis of syphilis of the testicle is as a rule not difficult. Tuberculosis and gonorrhea (Fig. 278) attack the epididymis and involve the vas. Syphilis

attacks the testicle and rarely invades the spermatic cord. It may be difficult to distinguish gumma from primary neoplasm of the testicle but the history, blood findings and reaction to treatment will readily differentiate. The characteristics of the syphilitic process are its painlessness and distinct hardness.

Periorchitis By this is meant an inflammation of the visceral and parietal layers of the tunica vaginalis testis (see Figs 60 and 61). A periorchitis may present clinically in either an acute or chronic form and a common result is the exudation of fluid in the cavity formed by the visceral and parietal layers of the tunica vaginalis, i.e. in the formation of a hydrocele.

Involvement of the visceral layer of the tunica vaginalis, with later adhesions between the two layers, often follows an acute gonorrheal epididymitis but any other inflammatory involvement of the epididymis or the testicle, however, may produce either a serous or fibrinous periorchitis. Occasionally an acute or chronic inflammation of the tunica may occur, with only a very slight hydrocele developing.

We have seen an acute periorchitis develop suddenly and clear up in a few days without formation of a hydrocele. In some cases, the tunica may be extensively involved with hemorrhages into its wall without much exudation into the sac. The term periorchitis hemorrhagica (Fig 289) is employed for this form. In these cases the involvement is most marked on the outer wall of the parietal tunica vaginalis. Some may be due to extension of infection downwards along the sheath of the vas.

HYDROCELE AND HEMATOCELE

HYDROCELE

Strictly speaking this term ought only to be used to designate an abnormal accumulation of serous fluid between the two layers of the tunica vaginalis testis, i.e., in the potential space between its parietal and visceral layers as shown in A of Fig 290. The term hydrocele has been employed for many years and is still so used to designate one of the following:

(a) An accumulation of serous fluid in the distal end of the nonobliterated vaginal process (see C of Fig 7) which is termed congenital hydrocele. The collection of serous fluid may persist as a true hydrocele (see D of Fig 290) after separation of the vaginal process of peritoneum and the tunica vaginalis testis.

(b) The term hydrocele of the cord is used to designate the accumulation or better the persistence of serous fluid in various compartments of the original vaginal process of the peritoneum of the embryo (see B of Fig 290).

(c) The term hour-glass hydrocele is applied to cases in which there is a free communication between the space between the parietal and visceral layers of what was destined to form the tunica vaginalis testis and a serous lined cavity extending along the vas deferens into the inguinal canal (see C of Fig 290) and at times into the true pelvis.

Not infrequently a true hydrocele, i.e., an accumulation of serous fluid between the two layers of the tunica vaginalis testis, is associated with an inguinal hernia as shown in D of Fig 290.

If one excludes the congenital type of hydrocele described above, due to failure of the lower end of the vaginal process to form a tunica vaginalis testis, practically all of the hydroceles observed clinically can be termed acquired or

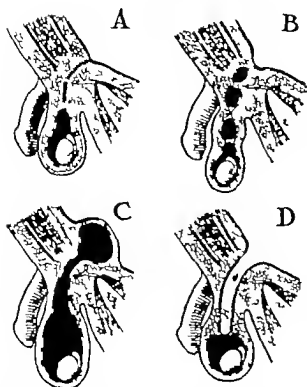


FIG. 290.—Various types of hydrocele. A. Hydrocele of tunica vaginalis (compare with Fig 300.)

B Multilocular hydrocele of cord.

C Hour-glass hydrocele

D Combination of inguinal hernia and hydrocele

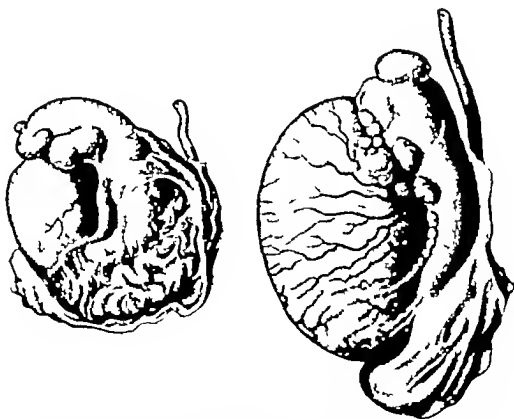


FIG. 291.—The specimen on the left shows a single cyst of epididymis while that on the right shows multiple cysts of the epididymis. (Courtesy of Dr. Rudolph Demel.)

more correctly secondary hydroceles and cysts of the epididymis (Fig 291) are not true hydroceles

Etiology of Acquired (secondary) Hydrocele In the order of their frequency the causes are

- 1 Nontuberculous (ordinary pyogenic, including gonococcal) infections of the various components of the seminal duct (testis, epididymis, vas deferens, etc)
- 2 Tuberculosis of the same structures
- 3 Syphilis
- 4 Neoplasms
- 5 Mumps (virus of)
- 6 Operations for varicocele or hernia
- 7 Thrombophlebitis of the pampiniform plexus
- 8 Filariasis and bilharziosis
- 9 Low grade systemic infections

A large number of cases are erroneously classified as idiopathic Careful palpation (Fig 91) of the scrotal contents will show that the vast majority of

FIG 292



FIG 293

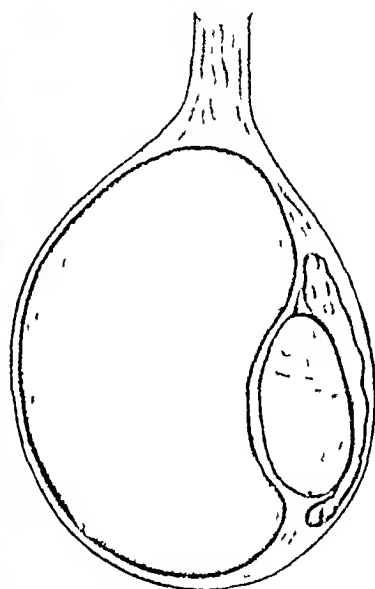


FIG 292—Simple method of determination of translucency in a scrotal swelling suspected to be a hydrocele One can also use a flash light in the form of a vest pocket pencil A paper rolled up as a cylinder transmits the light to eye of examiner as shown here

FIG 293—Sagittal section through a hydrocele of the tunica vaginalis from specimen in Prof Eberth's collection at Zurich, Switzerland

these so-called chronic idiopathic hydroceles have some pathology in the epididymis as the etiological factor Following aspiration of the hydrocele, irregularities in the testicle and hardening of the epididymis can often be noted

This chronic epididymitis, which is the etiologic factor in most cases of so-called idiopathic hydrocele, is most frequently secondary to a mild chronic non-gonorrheal urethritis in the middle aged In these patients, there is extension from the urethra along the seminal duct to the epididymis, the mild degree of epididymitis producing no symptoms

Acute Hydrocele This is usually secondary to an inflammation of the

epididymis or testis. It may however result from trauma of these structures with secondary inflammatory reaction. Gonorrheal epididymitis is always associated with some exudate (Fig. 278) into the tunica, this varying from 3 cc. to 40 cc. Syphilis may be the cause of an acute hydrocele which develops rapidly in the absence of any evidence of a preceding epididymitis or orchitis.

Acute epididymitis and orchitis from any other cause may also be associated with symptomatic hydrocele.

An acute secondary or symptomatic hydrocele usually clears up with the subsidence of its activating cause. Some persist and become chronic. Symptoms are usually absent, the accompanying epididymitis or orchitis causing the pain and distress. Plastic exudate and cicatricial changes may finally obliterate the vaginal sac. Suppuration rarely occurs.

Chronic Hydrocele. This is most common in the middle aged, between forty and sixty. It usually develops insidiously and produces little or no distress.



FIG. 294.—The photograph on the left is that of a patient with a bilateral hydrocele. The photograph on the right is that of a patient with an undescended testis in the femoral region, complicated by a hydrocele.

except when it assumes large proportions. Chronic hydrocele may also be secondary to acute hydrocele if the pathology in the testicle and epididymis persists.

PATHOLOGY OF CHRONIC HYDROCELE. The tunica is usually considerably thickened in long standing cases. There are many adhesions within the sac and the hydrocele may be multiflocular. Fibrinous bodies are often met with in opening the sac, like rice bodies. They consist of phosphates and carbonates covered with fibrin. The tunica propria covering the testis (Fig. 61) shows thickening and the testicle is often irregular, sometimes distorted and very often atrophic, the latter condition being probably due to pressure from the hydrocele. The epididymis if examined carefully at operation will usually show thickening most marked in the lower portion of the body or at the tail.

The fluid. Hydrocele fluid is an exudate, its specific gravity varying from 1020 to 1026. It is straw colored, contains a large amount of albumin and also

some globulin and fibrinogen. The fluid contains a few leukocytes, some endothelial cells, cholesterol and at times, small droplets of fat. The quantity of fluid in a hydrocele sac varies considerably. Some may reach large proportions. Most of the hydroceles contain from 100 to 400 cc.

Symptoms Chronic hydrocele develops slowly, painlessly and presents no symptoms except a sensation of dragging due to its weight and also some interference with motion. The hydrocele usually involves only one side, but it may be bilateral (Fig 294). It appears as a pear shaped tumor, larger below than above and tapering sharply at the cord. When of large dimensions, it is often sausage shaped. It cannot be reduced by pressure and cannot be pushed into the inguinal canal, unless it is of the bilocular type (C of Fig 290).

The skin of the scrotum is tense, shiny and somewhat reddened. When the hydrocele is large, the penis appears to be buried.

Diagnosis An enlarged tense scrotal sac which gives a sense of fluctuation and cannot be reduced, are characteristic signs of hydrocele.

Transillumination Hydrocele fluid transmits light and thus a light held against the scrotum (Fig 292) will transilluminate the hydrocele sac. The position of the testicle can often be determined. This method which is not infallible, is, however, the most valuable diagnostic aid other than aspiration. When the walls of the sac are thick, this test may fail.

Puncture and aspiration establish the diagnosis. Aspiration should be done only after hernia has been absolutely ruled out.

The history of a swelling of gradual onset, increasing slowly in size and not being reducible, are great aids in the establishment of a diagnosis.

Differential Diagnosis HERNIA gives an impulse on coughing and is reducible, unless incarcerated, but there is in the latter, a history of its being formerly reducible. Hernia often transilluminates, so that this test may be of no value. Hernia and hydrocele may coexist, particularly in congenital hydrocele.

SPERMATOCELE Large spermatoceles are less common (Figs 269 and 270) than hydrocele. The testis is in front and below, whereas in hydroceles it is

	Complete Inguinal Hernia (Reducible)	Congenital Hydrocele	Acquired Hydrocele
1 Location	Swelling continuous with inguinal region	Same as in hernia	Swelling terminates at upper end of scrotum, can feel cord above tumor (Fig 90)
2 Impulse	Distinct on coughing	No impulse	No impulse
3 Translucency	Not translucent, as a rule. Rarely so, in children	Translucent	Translucent unless greatly thickened sac
4 If reduced	Feel gurgling if contains intestine, reappears rapidly on coughing	Reduction very slow. Reappears slowly	Cannot be reduced
5 Relation to testis and cord	Lies above or in front of testis and in front of cord	Same as in hernia	Lies in intimate relation to testis, latter felt usually below and behind tumor
6 Palpation and percussion	Soft semi-elastic, dull if omentum, tympanic if intestine	Harder and more tense, dull on percussion	Pear shaped swelling, harder and tense, dull on percussion

behind Spermatocoeles are extravaginal the testicle being entirely outside of the cyst. The fluid is gray or pale and contains sperm. It contains no albumin.

HEMATOCELE There is usually a history of injury and the skin shows ecchymoses. Trauma to a hydrocele may produce a bloody effusion.

CHYLOCELE Chylocele occurs in the tropics; the fluid is milky or creamy in character being due to filariasis.

The following table shows the differentiation of a congenital hydrocele, acquired hydrocele and a reducible inguinal hernia.

WHEN COMPLETE AND IRREDUCIBLE The following conditions must be considered in making a diagnosis:

- Hydrocele of the tunica vaginalis (acquired hydrocele) (A of Fig 290)
- Hydrocele of the cord (encysted hydrocele) (B of Fig 290)
- Hematocoele (Fig 289)
- Enlargements of the testis especially neoplasms.

Some additional differential points are considered in the accompanying table.

	Complete Irreducible Inguinal Hernia	Hydrocele of the Tunica Vaginalis	Enlargements of Testis
Inspection	Tumor extends through external ring into inguinal canal.	Tumor terminates below external ring.	Same as in hydrocele.
Palpation	Expansile impulse on coughing. Feels soft if intestine firmer if omentum.	No impulse. Feels tense and elastic.	No impulse. Firm may be irregular.
Percussion	Tympany if intestine.	Dullness.	Dullness.
Relation to testis	Testis is below and behind tumor.	Testis cannot be distinctly felt.	Can outline enlargement of testis or epididymis.
Translucency	Negative except rarely in young children.	Positive unless tunica greatly thickened.	Negative.

TUMORS OF THE TESTIS They do not transilluminate (See Table)

They grow rapidly and show abdominal less often inguinal adenopathy (See neoplasms later)

Prognosis Hydrocele in infants and young children often get well spontaneously. Tapping of a hydrocele in children is often curative. Hydrocele in adults does not get well after tapping usually refilling. Tapping however gives relief for a long period. Hydrocele in adults does not get well spontaneously. It is never dangerous to life. It rarely suppurates and seldom becomes transformed into a hematocoele.

Treatment of Hydrocele (a) Tapping This may cure hydrocele in children but gives only temporary relief in adults and is rarely curative.

(b) Aspiration, followed by injection of five to ten minims of pure carbolic acid or the injection of iodine was the method of treatment in former times and is still being used by a few. The purpose is to produce enough inflammation to obliterate the sac. It has been generally discarded in favor of the open operation because the latter is more certain and produces less reaction and pain and because co-existing pathology is thus not overlooked. However there have been reports of large series of cases treated successfully in the past few years by the injection of small doses of a combination of quinine hydrochloride and urethane (Ewell Marquardt and Sargent)

(c) **Operative Procedures** The technic of radical cure of hydrocele consists of either eversion (bottle operation) or almost complete removal of the sac (see Chapter 50)

HEMATOCELE

This is an effusion of blood (Fig 289) into the cavity of the tunica vaginalis. It is usually traumatic in origin, but may follow operations on the epididymis or testis in which complete hemostasis was not secured. External injuries and hemorrhage into a hydrocele sac from the trauma of aspiration may also cause it. Occasionally it may be spontaneous, occurring in blood dyscrasias such as scurvy. Hematocele is uncommon as compared with hydrocele.

Symptoms of Hematocele The onset is rapid and there develops a painful swelling, following an injury or operation, due to the blood which distends the scrotal sac. Upon aspiration, the fluid is blood tinged or there may be clotted blood present. The fluid may be brown or even black.

With rest and support to the scrotum, the bloody effusion is gradually absorbed and usually does not require surgical interference. The pain is often quite severe, due to the sudden increased tension and the pressure from the active bleeding.

Treatment of Hematocele Rest, support and cold applications will usually relieve the pain and the blood will gradually be absorbed. If the pain continues and is severe, the sac should be incised, evacuated, packed and drained.

CHYLOCELE

This is a rare condition, found in the tropics, due to the *filaria sanguinis hominis*, and consists of the presence of chyle in the cavity of the tunica vaginalis. It resembles hydrocele and the treatment consists in excision of the sac.

NEOPLASMS OF THE TESTIS

Neoplasms in the scrotal contents may arise, (a) in the orchis or testis, (b) in the epididymis, (c) in the spermatic cord, and, (d) in the testicular tunics. The last three have been referred to in Chapters 19 and 20 so that only those taking their origin in the orchis or testis (Fig 60), will be discussed here.

Tumors of the testicle are relatively rare,¹ comprising 5.8 per thousand (0.58 per cent) of all malignant tumors in men. There is still much discussion as to their pathology but from the clinical standpoint there is no difference of opinion as to the fact that all tumors of the testis are malignant. They occur far more frequently than tumors, either benign or malignant, arising in the epididymis, vas deferens and its coverings or in the testicular tunics.

PATHOLOGY²

Wilms in 1896 was the first to demonstrate conclusively that most tumors of the testicle are of teratomatous origin. In 1911 Ewing made a painstaking

¹ Hinman and Gibson, Arch Surg, 1924, 8, 100, January

² We are indebted to the excellent article of Hinman, Gibson and Kutzmann, Ann Surg, 81, 552 (Jan), 1925, for assistance in the preparation of this chapter.

analysis¹ of the previously reported cases and added nineteen of his own. He reached conclusions which if they could be fully accepted would greatly simplify matters. He believed that pure tumors of mesoblastic origin such as fibroma, chondroma, myxoma and lipoma are extremely rare and that most of such benign tumors have been derived from teratomas. He also held that malignant tumors are likewise teratomatous in origin.

Chevassu classified these tumors into 2 types: the seminoma and teratoma. The seminoma or spermatocytoma (Fig. 295), frequently miscalled round-celled sarcoma, arises from the seminiferous tubules and is usually a solid cream-colored tumor. In the teratoma the various tissues of the body may be represented. This has caused considerable confusion in the classification of these tumors. All are malignant. The classification of testicular tumors by Ferguson into various types of teratoid growths has clarified the entire picture of the disease and has made possible the differential diagnosis as to their degree of malignancy. He classifies these tumors into 5 groups with an increasing degree of malignancy in each succeeding group.

1 **Adult Cystic Teratoma.** This consists of a highly irregular mixture of tissues originating from the 3 primary germ layers. Cartilage, muscle, embryonal tissue of various kinds and other tissue may be present. This tumor grows slowly over a long period of time, reaches large proportions and is least malignant.

2 **Seminoma (Fig. 295).** This grows more smoothly and rapidly than the first and attains a large size in a few months.

3 **Embryonal Carcinoma with Lymphoid Stroma.** This tumor is soft and attains medium size.

4 **Embryonal Adenocarcinoma (Fig. 296).** This growth usually arises from the rete testis. The growth is rapid, does not attain large size and is highly malignant.

5 **Chorion-epithelioma of the Testis.** This is a highly malignant tumor confined to the rete testis and as a rule is seen only when metastases are already present.

Regional and Generalized Metastasis. Neoplasms of the testis metastasize in one or more of the following ways:

1 **BY WAY OF THE LYMPHATICS OF THE SPERMATIC CORD.** The lymphatic drainage of the testis is well illustrated in Fig. 63. The vessels drain into various lymph nodes along the aorta from its bifurcation to the level of the renal vessels. Occasionally one finds a few nodes over the sacral promontory. The secondary involvement of these retroperitoneal lymph nodes may attain enormous size. From the nodes around the renal pedicle the lymphatic drainage is toward the mediastinum and root of the lungs as well as toward the nodes of the supraclavicular fossa (left). On account of this relation to the lymphatics, metastasis to the lungs (Fig. 172) and pleurae may occur at a relatively early stage. We recall one case in which a patient was thought to have a pulmonary tuberculosis by an internist who had neglected to ascertain that a neoplasm of the testis had been removed eighteen months before.

2 **BY WAY OF THE VEINS.** This mode of metastasis gives rise to early pul-

¹This comment on Ewing's work is taken from an article on Histogenesis of Malignant Tumors of the Testicle by Drs. Oscar T. Schultz and D. N. Eshenrath, Arch. Surg., 1921, 2: 493.

monary metastases (Fig 172), hence one should never omit routine radiography of the chest, especially when there are no palpable retroperitoneal lymph node metastases

3 TO THE MORE SUPERFICIAL LYMPH NODES Involvement of the inguinal nodes is rare, except when the scrotum is involved, because the lymphatic drainage of the latter is separate from that of the testis

Sequelae of Abdominal Metastases The metastases are of the same histologic structure as the original tumor. The metastases in the lumbar lymph nodes eventually form a huge confluent mass, through the center of which pass the aorta and vena cava. Not alone are the retroperitoneal tissues invaded, but extension in some cases takes place to the lumbar vertebrae and may cause paraplegia.⁴ Both

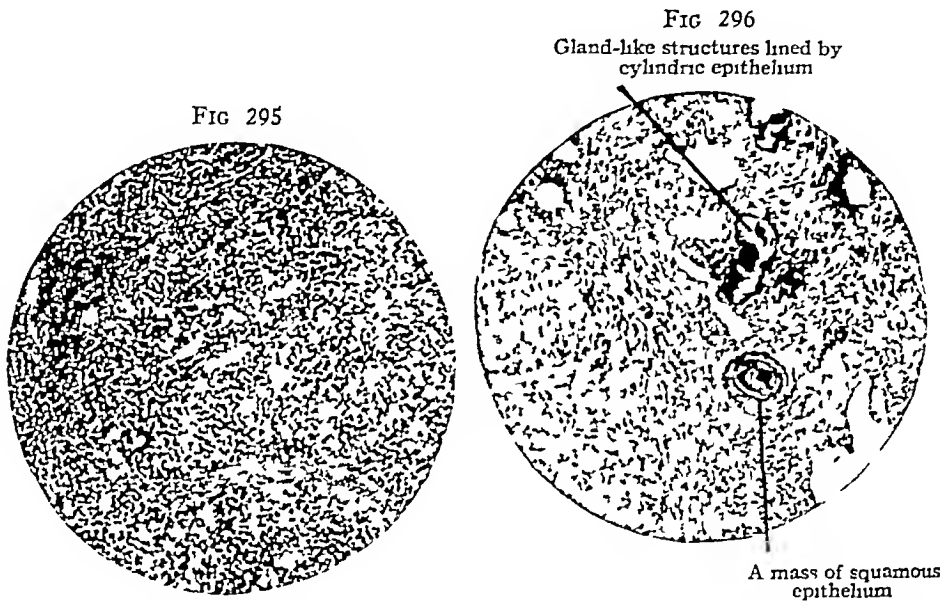


FIG 295—The large celled indistinctly alveolar tissue of a spermatocytoma of the testis. At the side is an island of lymphocytes

FIG 296—Differentiated heterologous tissue of tumor of testis of the embryonal carcinoma type

ureters may be obstructed with resulting hydronephrosis and uremia. The most common clinical manifestation of the lumbar metastases is, however, intestinal obstruction, according to Cairns (*loc cit*). This is due to the formation of adhesions between the small intestine and the anterior surface of the growth. Invasion of the lumen of the inferior vena cava may be followed by thrombosis of the vein and marked edema of the legs, or by a pulmonary embolism.

Relation of Tumors of the Testis to Injury That an injury can directly give rise to a neoplasm of the testis is improbable. In fourteen of seventy-nine cases studied by Cairns, the testicular enlargement followed or was first observed, shortly after a local injury. Other observers, according to Cairns, have obtained a history of injury in fifty per cent of their cases. In seventy per cent of Young's cases, there was no history of injury and we agree with his opinion that the blow merely calls attention to a mass already present.

Relation of Tumors to Non-descent of the Testis We have already⁵ referred to this in discussing non-descent of the testis. In addition to the observa-

⁴ Curling's case cited by Cairns

⁵ The opinion was, that neoplasms occur relatively more frequently in the undescended testis

tions of Coley and others quoted there we can add those of Cairns, who found that in only five of seventy seven cases studied by him was the testis not in the scrotum. In one of two cases in which the testis was lying on the external oblique aponeurosis, the tumor was discovered accidentally during an operation for torsion of the cord. Dean found that in six of sixty three cases the testicle had not descended.

The majority of tumors of imperfectly descended testes are found in cases in which the testis lies in the inguinal canal or between its anterior wall (external oblique aponeurosis) and the skin, where it is poorly protected against injury. The relative infrequency of tumors of an abdominal testis⁶ is borne out by the fact that only about seventy five cases have been collected. Milch⁷ has recently added two to this number.

SYMPTOMS AND DIAGNOSIS

The patient either (a) complains of the presence of a swelling in the scrotum which has been gradually increasing in size or (b) he complains of abdominal or pulmonary symptoms due to the metastases and the testicular enlargement is found during a search for a possible cause. In the majority of cases, there is an absence of pain at first but later it is often present. The mass is usually smooth and freely movable. Its exact character i. e. whether it is an enlargement of the testis or of the epididymis is often obscured by an accompanying secondary hydrocele (Fig. 278). The onset in cases of testicular neoplasms is so insidious that one should always be suspicious. If an ovoid painless scrotal swelling is palpated. If hydrocele is absent, it is easy to determine the fact that it is the body of the testis which is enlarged and not the epididymis. Recalling what has already been emphasized in Chapter 19 that the only conditions which give rise to enlargements of the testis are injury and mumps in acute (Fig. 306) and syphilis and tumors in chronic cases an exclusion of all conditions except neoplasms presents no difficulties. At times it is necessary to make the Wassermann test or if doubt still exists to give iodides and arsphenamin for a short period (never more than one week) in order to rule out a possible syphilitic orchitis. One must remember however that a neoplasm can occur in a syphilitic.

The sac of the secondary or symptomatic hydrocele which makes it so difficult to palpate, in a certain proportion of cases of neoplasms of the testis is often so thick that it does not transmit light (Fig. 292). It is not advisable to aspirate the contents of the hydrocele because of the danger of carrying some of the tumor cells into the scrotal tissues if the point of the trocar should enter the testis. Should there be any doubt about the question as to whether or not the testicular enlargement is due to a neoplasm, we believe it to be far better to perform an exploratory operation preceded by palpation of the abdomen for metastases. No preoperative examination of a suspected neoplasm should be considered complete without both abdominal examination and radiography of the chest. We have found pulmonary metastases in one case before there were any scrotal symptoms.

Hernatocele and hydrocele may give rise to pictures closely resembling neoplasm. In both conditions the testicular enlargement is completely overshadowed

by the fluid around it and not infrequently the fact that a neoplasm is in reality the underlying condition, is not discovered until the hydrocele or hematocele sac has been opened at operation. A spermatocele (Figs 269 and 270) (see Chapter 20) or cyst of the epididymis (Fig 291) is usually small enough so that the testis can be palpated as being of normal size and separated from the cystic swelling. The differentiation from a tuberculous epididymitis only presents difficulty if this structure and the testis are matted together and are obscured by a secondary hydrocele. In such cases, palpation of the vas for a beaded condition is of value, but as was stated in Chapter 20, the vas may be simply uniformly thickened and not beaded. Rectal palpation is of great aid, but secondary tuberculous nodules in the prostate are only found in relatively advanced cases of tuberculous involvement. The epididymis when palpable, presents the typical nodulated surface described in Chapter 19 and the testis itself is seldom enlarged, except very late.

The finding of the excretion in the urine of Prolan-A, the gonadotropic hormone of the anterior pituitary, in varying quantities in tumors of the testis has been the greatest advance in our knowledge of this subject. The quantitative determination⁸ of Prolan in the urine indicates the type of tumor, the extent of the disease, and the effect of treatment.

This test is not only of diagnostic, but also of great prognostic value. Thus, the highly malignant chorionepithelioma will cause excretion in excess of 50,000 or more mouse units of Prolan-A per liter of urine. The adult type of teratoma, which is the least malignant, usually shows only 50 to 500 units per liter of urine. With the removal of the primary growth in the absence of metastases the Prolan disappears from the urine within 2 weeks. The effect of radiation can also be determined by the Prolan determination. If there is no reduction in the Prolan the tumor is radio-resistant, or metastases are present. Although this test for Prolan-A is of extensive value, it has failed us in 2 early cases of tumor of the testis where the findings were negative. Orchidectomy was done in each case and a tumor found.

TREATMENT

It is generally agreed that when a testicular tumor has been diagnosed preliminary radiation should be attempted, and then followed by simple orchidectomy. Following operation an extensive course of radiation should be given to help prevent the possibility of metastases. The extensive operation advocated by Hinman, removal of the entire cord and the lymph nodes draining this region, can be of little value if metastases are present because all the metastatic areas cannot be removed. In the absence of metastases simple orchidectomy is sufficient.

THE SCROTUM

Anomalies and Malformations In nondescent of the testicles, the scrotum remains undeveloped and small. In hypogenitalism the scrotal sac is also small accommodating itself to the size of the testicle. There are many normal variations in size, of the scrotum. The scrotum may be large and contain average sized testicles with considerable loose areolar tissue in the sac. In hypospadias (Fig 238)

⁸ Keyes & Ferguson, Text Book of Urology

the scrotum may be partly or entirely cleft and the penis may be adherent to the scrotum. The scrotum is often very redundant.

Injuries of the Scrotum. The scrotum may suffer extensive injury without injury to the testicles because the latter slip away from the line of force. In penetrating injuries the bleeding is profuse and ligation is necessary lest a hematoma develop. The skin when sutured should be carefully apposed because of its tendency to inversion. Regeneration of the scrotum following extensive loss of tissue as the result of trauma or gangrene, occurs in a remarkable manner. The scrotum will completely regenerate in a few weeks after extensive destruction.

Edema of the Scrotum. This is very commonly associated with generalized edema in nephritis and cardiac failure. The edema of the penis and scrotum in nephritis presents a characteristic picture and may be the first visible evidence of the generalized edema. Inflammatory edema of the scrotum may result from infection within the scrotum and may be quite extensive.

Edema may result from blocking of the lymphatics in chronic inguinal adenitis. There is an associated edema of the penis. Edema follows compression due to tight bandaging and poorly fitting suspensories.

The edema due to chronic inguinal adenitis with blocking of the lymphatics presents at times a picture simulating true elephantiasis and erroneously termed so.

Tumors of the Scrotum. Small sebaceous cysts appearing white and some what elevated, are frequently found in the skin of the scrotum. They usually remain small and are of no importance. Fatty tumors, fibromata and occasionally gumma of the scrotum may be seen.

Epithelioma of the scrotum formerly called "chimney sweep cancer" or "coal tar workers cancer" is rare. The tumor begins as an indurated area which gradually spreads, later ulcerates and discharges fetid pus. The inguinal glands become involved when the process is advanced. Early diagnosis with removal of the tumor and considerable adjacent skin gives a good prognosis.

Abscess. Abscess within the scrotum may follow acute infections of the epididymis or spermatic cord. A large abscess within the scrotum and outside of the tunica may follow an abscess of the epididymis. Funiculitis may produce an abscess which gravitates to the scrotum.

Multiple chronic abscesses with sinuses (Fig. 197) and marked brawny edema of the scrotum are secondary to extension of perilurethral abscesses (Fig. 188) in strictures of the bulbo-membranous urethra. These are usually found at the median raphe.

Fistulae. Multiple sinuses, most often secondary to tuberculosis of the epididymis⁹ are common. There is involvement of the wall of the scrotum with discharge of pus. Urinary infiltration and perilurethral abscesses of gradual development will produce numerous fistulae in the scrotum. Scrotal calculi may form from the deposits of calcium and phosphates in the urinary fistula due to stricture. These fistulae are usually in the midline and low in the scrotum.

In operating on these fistulae¹⁰ the stricture of the urethra should also be relieved by external urethrotomy. Free incision, curettement and excision of the long standing fistulae are necessary to cure the condition.

⁹ See Chapter 70.

¹⁰ See Chapter 13.

Urinary Extravasation into the Scrotum This attacks the scrotum early the extravasation not being interfered with, in its spread to the scrotum The latter becomes red, edematous, painful and early gangrene follows Free incisions and drainage¹¹ should be made early

Emphysema This may be a part of general subcutaneous emphysema due to rupture of the pleura and lungs It may occasionally follow operations on the kidney, and is due to extension of air from the kidney region downward along the retro-peritoneal space We have had 3 such instances in which the emphysema cleared up within a week We have seen one case where as the result of a tear in the pleura there developed, generalized, including scrotal emphysema The latter may also occur in gangrene of the scrotum and be due to gas forming organisms When due to the latter, free incision and irrigation of the wound should be done

Gangrene of the Scrotum Aside from gangrene, secondary to extensive injury, infection or urinary extravasation, this condition may appear as an apparently primary clinical entity In some cases, it follows ulceration of the penis In others, it appears suddenly, apparently not secondary to infection elsewhere, and is probably of hematogenous origin

OTHER CASES OF SCROTAL GANGRENE MAY BE DUE TO THROMBOPHLEBITIS OF THE PELVIC PLEXUS OF VEINS We have recently seen one case with gangrene of the penis and scrotum which ended fatally as the result of this Erysipelas of the scrotum is considered by many to be identical with gangrene Many of the cases are in reality erysipelas, others, however, cannot be classified as such

These cases of gangrene of the scrotum are not rare There is usually a chill at the onset with beginning redness and swelling of the scrotum Within forty-eight hours, the gangrene is noticeable and usually spreads rapidly, destroying almost the entire scrotum The patient has some fever and toxemia, this disappearing in four to five days when the gangrene has usually ceased spreading When the destruction is complete, the typical picture presents the two testicles hanging exposed, without any covering The remarkable regenerative capacity of the scrotum produces complete regeneration of the scrotal sac in six to eight weeks and leaves very little evidence of the destruction of tissue

With the gangrene of the scrotum, the subcutaneous tissue sloughs also but the testicles and their coverings remain unaffected Abscess and gangrene are frequently associated, the gangrene, as a rule, being secondary to the abscess and not marked

TREATMENT OF GANGRENE OF SCROTUM Weak solutions of potassium permanganate are said to be of value Wet dressings and general treatment are indicated It is best to wait until demarcation has occurred and then remove the gangrenous tissue gradually

Elephantiasis This is a disease, endemic in certain tropical countries and is due to lymphatic obstruction by the *filaria sanguinis hominis* The scrotum reaches enormous proportions It is practically unknown in temperate climates The swelling spreads in all directions and the skin becomes thick, hard, rough and at times, warty The condition is chronic Complete excision of a large part of the scrotum is the procedure adopted for relief

Cutaneous Affections Intertrigo is frequent in children and in stout individuals Cleanliness, daily baths, interposition of soft muslin between the chafing

¹¹ See Chapter 13

surfaces of scrotum and thigh and in its prevention. Powdered zinc oxide or zinc oxide ointment as applications are of value.

Eczema may also occur. Pediculosis pubis usually involves the scrotum also and causes considerable pruritus. Shaving of hair and application of mercurial ointment clear up the condition.

Secondary syphilides frequently affect the scrotum. It may be the only portion of the external surface where they are noticeable. They are often moist condylomata.

CHAPTER 22

STERILITY IN THE MALE

REQUISITES FOR FERTILITY

STUDY OF THE MALE
CAUSES OF STERILITY
RESUME OF PHYSIOLOGY AND PATHOLOGY
ACCESSORY SEX GLANDS
THE SEMEN AND SPERMATOOA
SEMEN
SPERMATOOA

EXAMINATION OF SEMEN

FERTILITY AND INFERTILITY
DEFECTIVE PRODUCTION OF SPERMATOOA
HOSTILITY IN THE SEMINAL DUCT
FAULTS OF DELIVERY
TREATMENT
STERILIZATION IN THE MALE

Any investigation of sterility necessarily requires the study of both the male and female of a sterile marriage. Although the examination of the semen is a relatively simple procedure, the investigation of the accessory sex organs and the interrelating endocrine glands, are often necessary to evaluate the factors in sterility and lowered fertility in the male.

Within recent years there has been an intensive study of sterility in the female. The three distinct advances which are of practical application, are the postcoital test of Huhner, the better understanding of the metabolic factors and the Rubin test of tubal patency. The studies of the female sex hormone by Frank and his associates and their clinical application, although still in the experimental stage, give considerable promise. It is evident that the female sex hormone is in the corpus luteum and can also be extracted from the placenta and that disturbances in the corpus luteum affect ovulation and pregnancy. Radiography of the uterus and tubes for the investigation of possible obstructive sterility in the female has not only demonstrated patency or occlusion, but also aided in the knowledge of the physiology of the fallopian tubes. No definite clinical or experimental proof has been given of the existence in the blood of a spermatotoxin, which may produce antibodies for the sperm or sensitize the individuals to spermatozoa.

The study of sterility in the female is taken up in the various gynecologic textbooks and monographs, hence it will not be elaborated upon here. It is well, however, for the urologist to comprehend that although the semen may show numerous normal sperm, there may be certain defects in the reception of the semen by the female, that interfere with fertility. Hostile endocervical secretions, due to infections and alterations of the reaction of the secretion, will destroy the sperm.

REQUISITES FOR FERTILITY

- 1 The testis must produce normal spermatozoa
- 2 The spermatozoa must pass through the male genital tract and be undamaged
- 3 The cervix must be inseminated at ejaculation
- 4 The endocervical secretions must be favorable to spermatozoa
- 5 The tubes must allow the ascent of the spermatozoa and the descent of the ovum
- 6 The ovaries must produce normal ova

The urologist is particularly concerned with the first two and to some extent with the third

The proper production, transportation and transmission of the spermatozoa is the function of the male and any defects in the process interfere in varying degrees with possibilities of fertility

STUDY OF THE MALE

1 **Production of the Spermatozoa** Any systemic, local or endocrine disturbance which will interfere with the function of the seminiferous tubules both in the quantity and the quality of the sperm produced, causes various degrees of sterility

2 **Hostility in the Passages.** The failure of the epididymis, vesicles and prostate to produce their normal secretion or the secretion by these structures under pathologic conditions, of substances that are hostile to the spermatozoa or infections in any of these structures all affect the number and vitality of the spermatozoa unfavorably

3. **Obstruction in the Passages** Obstruction in the epididymis vasa deferentia and ejaculatory ducts, follow inflammatory processes in these structures. They may also be of congenital origin

4 **Failures in Delivery of the Spermatozoa** Congenital or acquired defects which make coitus difficult or impossible and which prevent proper insemination of the female are frequent causative factors in sterility. The following is an outline by Meaker of the causes of sterility in both sexes which can be used as a guide.

CAUSES OF STERILITY

Defective production of spermatozoa	Testicular overdevelopment	Exhaustion from sexual excess	{ Metabolic faults of triadic order Debility Intoxication
	Testicular underfunction	Depressed constitutional states	
	Testicular trophy	Endocrine failure	
a. Obstruction or hostility in the male passages	Obstruction in epididymis, vas deferens and ejaculatory ducts		
	Hostility of prostatic, vesicular and epididymal secretions	Acidity Viscosity Infection	
b. Faults of delivery and reception	Intercourse lacking, or incomplete	Male faults	{ Malformation Impotence
		Female faults	{ Malformation Dyspareunia
	Intercourse without cervical penetration	Mutual maladjustment or disproportion	
		Male faults	{ Premature ejaculation Hypospadias Stricture
		Female faults	{ Anteversion of cervix, caused by retroversion of uterus Anteflexion of cervix Elongation of cervix Descent of uterus Redundancy of vaginal walls
c. Hostile endocervical secretions	Acidity Viscosity Infection Serologic hostility	{ Bacterial Nonbacterial	
d. Total occlusion	Developmental defect Inflammatory damage Mucous spasm		

6 Defective ovulation	Ovarian underdevelopment	{ Infantilism Juvenilism	
		Mechanical faults	{ Periovarian adhesions Thickened tunica albuginea Retention cysts Persistent corpora lutea
	Ovarian underfunction	Depressed constitutional states	{ Metabolic faults of extrinsic origin Debility Intoxication
	Ovarian atrophy	Endocrine failure	

The male is the responsible factor in from thirty-five to fifty per cent of sterile marriages. Since the semen can be readily procured, examination of this for spermatozoa and extraneous substances should be undertaken before subjecting the female to the more difficult, trying and considerably less exact test than is that of simple examination of the semen.

The sexual life of man is dependent upon the proper correlation of the various organs and structures which affect it directly and indirectly.

The testicle is the chief sex organ, both for internal secretion and spermatogenesis. Spermatogenesis occurs only in the seminiferous tubules of the testicle. The epididymis, seminal vesicles and prostate, which are accessory sex organs, are structures whose physiology is still not well understood. It is known, however, that their secretions are necessary for the proper functioning of the sperm.

The other endocrine glands, the pituitary, pineal, thymus, thyroid and adrenal cortex are interrelated sex glands. Disturbances in any one of these structures may destroy the fertility of the individual and alter the secondary sex characteristics.

The influence of the central nervous system, the sympathetic and parasympathetic nerves are also factors which, while not clearly evaluated, must be considered.

RÉSUMÉ OF PHYSIOLOGY AND PATHOLOGY

It may be well therefore, before taking up the study of the semen, which is the product of the secretion of the testicle, the seminal ducts and accessory glands, to review again some of the physiology and pathology of the genital glands and ducts as well as that of the interrelating endocrine glands to the extent that they influence spermatogenesis.

The Testicle

The spermatogenic function of the testicle is located in the seminiferous tubules, the cells going through a series of divisions (Fig. 297) before the spermatozoa are developed. The cycle consists of 1 Spermatogonia 2 Spermatocytes 3 Prespermatids 4 Spermatids and 5 Spermatozoa. Any condition affecting the internal secretion of the testicle will readily interfere with its spermatogenic function.

The spermatogenic function of the testicle is the most sensitive and highly developed in the human body and is readily influenced by any systemic or local disturbance.

The endocrine function of the testicle is intimately associated with that of the other endocrines mentioned above. The seat of the internal secretion of the

testicle is not definitely determined. Recent evidence appears to show that it does not lie in the interstitial cells but that it is probably in the seminiferous tubules.

The internal secretion of the testis was isolated and assayed by Moore, Koch and their associates and consists of 2 hormones chief of which is androsten. The other is called inhibin.

ANDROSTEN, which is the homologue of theelin in the internal secretion of the ovary, is found only in small quantities in extracts of the testis and in much greater amounts in the urine. The hormone found in the urine is slightly different from that present in the testis. The androgen that is isolated from the urine is

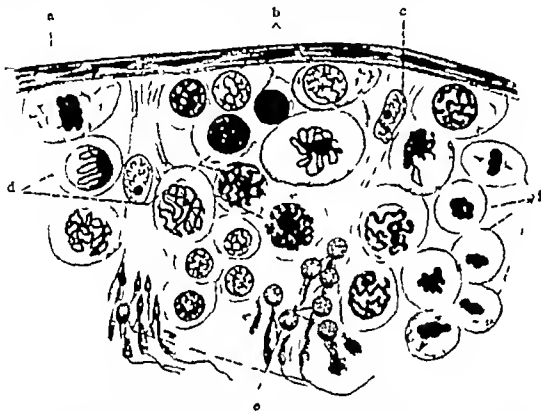


FIG. 297.—Spermatogenesis. Portion of the wall of a human seminiferous tubule (after Retzius). a. Wall of tubule. b. Spermatogonia. c. Sertoli cell. d. Spermatocytes. e. Spermatids in incipient stage of evolution to spermatozoa. f. Spermatocytes in process of division.

known as andro-sterone, and that purified from the testis tissue is known as testosterone. Both theelin and androsten are closely related to the cholesterol, and synthetic preparations of these products can be made in large quantities from cholesterol. Androsten, which is not stored in any appreciable quantity in the testis or in any other portion of the body, has a direct stimulating action on the accessory sex organs, the prostate and seminal vesicles. The urine of pregnant women, male castrates and patients with testicular tumor excrete a gonadotropic hormone in the urine, which is probably due to secretion by the pituitary gland and is not the same as androsten. Because the male hormone is found in only small quantities in the testis, medication with testicular extract from various conditions can be of little or no value.

INHIBIN is the other internal secretion of the testis which counteracts the effect of the pituitary gland, thus maintaining a normally functioning prostate and seminal vesicles. In the absence of inhibin there is a hyperactivity of the pituitary gland. Attempts have been made by Lower and his associates to treat and prevent

prostatic hypertrophy by the administration of inhibin, on the assumption that hyperactivity of the pituitary, due to lack of this substance in old men, is the cause of prostatic hypertrophy. This is still in the experimental stage. It is interest-

ing to note that the urine of the female contains a greater amount of male sex hormone than does the male, and that the urine of the male contains a greater amount of female sex hormone than does the female. It is thus seen that all individuals are to some degree bi-sexual, and that disturbances of the interrelationship of the gonads with the pituitary and the other glands of the body may cause various types of sexual abnormalities.

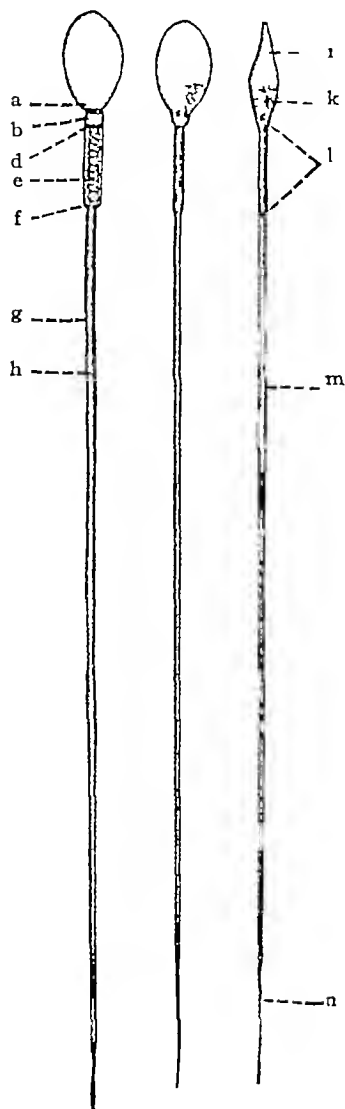


FIG 298—Mature human Spermatozoa. The illustration on the extreme left is after Meves, while the middle illustration and the one on the right represent a mature Spermatozoon as seen from the front and in profile respectively (from Retzius).
a Anterior nodule, b Neck, d Posterior nodule, e Spiral thread, f Annulus, g and h Body and tail

Epididymis

The secretion of the epididymis constitutes the bulk of the semen. It is well known that bilateral occlusion of the epididymes diminishes the quantity of the ejaculation to one-sixth or one-eighth of normal. The spermatozoa constitute only about ten per cent of the semen.

The epididymis is a coiled tubule (Fig 62) twenty feet long, through which the spermatozoon which is $1/500$ of an inch long, must travel 100,000 times its own length, a distance equal to the length of the small intestine, before reaching the vas. The function of the secretion of the epididymis is not well understood. It does not activate the sperm. It may give the spermatozoa a protective coating.

The epididymis is also an excretory organ, the body of the epididymis excreting substances injected into the blood stream (See Chap 20 and Fig 274).

Epididymitis usually produces permanent occlusion of the epididymis. Bilateral epididymitis is the most common cause of obstructive sterility in the male.

The Vas Deferens

The spermatozoa pass through the epididymis by secretory pressure and travel along the vas to some extent by peristalsis of the vas but chiefly by either secretory pressure or their own motility. Occlusion of the vas deferens is not an uncommon etiologic factor in obstructive sterility.

Seminal Vesicles

These are the store-houses for the spermatozoa. Pathology in the vesicles may act in different ways to destroy the sperm. Pus and bacteria will kill the sperm. Chronic inflammation of the mucosa of the ampulla and vesicle may destroy the ability of these structures to secrete, their secretion

apparently having the function of activating the spermatozoa. Without this secretion the spermatozoa may remain inactive or their activity lessen.

Prostate

The secretion of the prostate prolongs the life of the sperm and is therefore an important part of the semen. The prostatic secretion is, however, not absolutely necessary for the viability of the sperm. No internal secretion has as yet been demonstrated for the prostate. The prostate and vesicles are, however, of considerable importance aside from their secretion in that they are well innervated. Pathological changes in these structures produce various local and sexual disturbances. The secretion of the prostate gives the characteristic odor to the semen.

THE ACCESSORY SEX GLANDS

The Pituitary. Changes in the anterior lobe produce disturbances in function such as are characterized by Froelich's syndrome.¹ It is known that a large percentage of those castrated before puberty will show marked elongation of the long bones due to the uninhibited action of the pituitary.

The Thymus. This structure is apparently antagonistic to the development of the gonads. Persistence of the thymus is seen in men who are castrated early in life. Under pathologic conditions persistence of the thymus delays puberty.

The Pineal. Tumors of the pineal gland have produced early development of the secondary sex characters and precocious puberty.

The Thyroid. Disturbances of the thyroid produce changes in the internal secretion of the testicles and affect spermatogenesis. Cretinism, various forms of hypothyroidism and myxedema are associated with loss of the secondary sex characters and libido. Thyroid therapy is of great value in the treatment in the female of certain forms of dys- and amenorrhea.

Adrenal Cortex. Tumors of the adrenal cortex in children give rise to sexual precocity and when developing in the female after menopause cause the growth of hair with the same distribution as in the male. In Addison's disease there is usually such marked hypotension and weakness that the sexual disorders are only secondary.

The Cerebrospinal Nervous System. Injury to the ganglia at the base of the brain resulting in atrophy of these structures will often lead to atrophy of the testicles. Diseases of the spinal cord as tabes are accompanied by impotence but have no direct effect on spermatogenesis. It is thus seen that the testicles, the accessory sex organs and the other internal secretions jointly or separately affect spermatogenesis and that diseases of these structures are important causes of sterility.

THE SEMEN AND SPERMATOZOA

The causes of sterility as outlined by Meaker concern both the male and female. 1. The defective production of spermatozoa. 2. Obstruction or hostility in the male passages and 3. faults of delivery and reception. These are the problems which concern the urologist.

¹ See Chapter 21.

SEMEN

The diagnosis of sterility or fertility in the male is based upon the examination of the semen. Genito-urinary, endocrine and general study are also necessary, to determine the causes for sterility or reduction in fertility.

Spermatogenesis does not begin before puberty. It reaches its maximum four to five years later, remains at this level for many years and gradually recedes past middle age, so that the average man ceases to produce sperm at the age of seventy.

The semen consists of secretion from the seminal ducts and all of the accessory glands plus the spermatozoa. The epididymal secretion probably helps to prolong the life of the sperm while the secretion of the prostate and vesicles activate the spermatozoa and protect them against the hostile acid vaginal secretions.

The amount of semen varies with each ejaculation and also with the frequency of coitus, it averages from 2 to 4 cc. It has a peculiar odor and appearance. It is alkaline and liquefies on standing. The solid substances of the semen are nearly all organic and constitute nine to ten per cent of the bulk. They consist of nucleoproteids, albumin, mucin and cholesterol.

Spermin crystals are precipitated from the semen on standing. The rapid appearance of spermin crystals in large numbers, usually indicates a lowered vitality of the sperm. The spermin also helps to give the odor to semen. Charcot-Leyden crystals appear rapidly and in large number when few or no sperm are present.

Abnormal Products in the Semen The presence of pus, amyloid and hyaline bodies, as well as increase in mucus, indicates a prostatovesiculitis. The mucus interferes mechanically with the motility of the sperm while the pus and bacteria deform, or destroy the sperm. A small amount of pus is not incompatible with active motility of the sperm and in some cases the spermatozoa may be active even in the presence of a large amount of pus. The quantity of mucus in the semen is increased with longer intervals between coitus and there is very little with frequent coitus. The persistence of starch bodies, whose origin is not well understood, is evidence of interference with fertility.

SPERMATOOA

The normal sperm (Fig. 298) has a short pear-shaped, broad head, small neck and long tail and may remain alive from two to forty-eight hours on the slide. It has been found alive in the uterus, seven to ten days after coitus.

The length of the tail is important, sperm with a long tail having higher degree of fertility. The motility of the sperm does not necessarily indicate functional value, but it is the only index we have.

Spermatozoa constitute about ten per cent of the semen, the number with each ejaculation varying from fifty to five hundred million. Variations in number, form, motility and duration of life on the slide or in the cervix, and the presence or absence of extraneous substances, constitute the means of diagnosing degrees of fertility and sterility.

Other Influences on the Sperm and Semen Dead spermatozoa do not come to life again. It is claimed that spermatozoa which have ceased motility after having been allowed to stand in the cold over night, can be reactivated by

warming. We have never attempted to verify this. The acid urine kills the spermatozoa. Heat and cold, antiseptics, contact with urine and altered secretions of the glands, interfere with their motility or destroy them. Ejaculated semen with out sperm although usually distinguishable from that which has sperm may at times have a gross appearance like that of the normal.

Corpora amylacea from the prostate are common in elderly men and are found when the number of sperm is few. In azoö-spermia there are often present lecithin, corpora amylacea, epithellium and prostatic crystals. Gelatinous sago-like bodies come from the vesicles and the presence of pus or red cells indicates an infection of the prostate and vesicles.

The Florence test for semen is of medicolegal importance and consists in the use of a solution of iodine 1.65 gram, potassium iodide 2.54 gram and water 30 cc. Dried semen is washed off the clothes, etc. and a drop of Florence solution alongside produces brownish red rhomboid crystals. This test is claimed, however, to be specific only for the presence of lecithin.

PATHOLOGIC VARIATIONS OF THE SPERMATOZOA

Terminology

Azoö-spermia indicates the absence of spermatozoa.

Aspermia—the absence of semen. Inability or failure to ejaculate.

Asthenospermia—a term not commonly employed indicates sperm of low vitality.

Oligospermia—this indicates the reduction in the number of spermatozoa.

Necrospermia—dead sperm.

Oligospermia occurs normally at puberty and in old age and cannot always be considered as pathologic if the sperm present are actively motile.

Physiologic Azoö-spermia. This is often present immediately after coitus but is by no means a constant finding because spermatozoa can usually be found after repeated coitus. We have noted the absence of sperm in married men who had indulged excessively. The spermatozoa reappeared with longer intervals between coitus.

Congenital Azoö-spermia. These cases present a problem to the urologist. They are not uncommon. Men apparently normal in every way with normal libido who are potent and give no history of any infection or trauma to the genitalia and who present no symptoms, may have no spermatozoa in the semen. Many factors may enter into the causes of congenital azoö-spermia other than the failure of spermatogenesis. Congenital occlusion somewhere along the seminal duct may be a cause. In congenital azoö-spermia we have been unable to procure sperm from the testicle by puncture and aspiration. The treatment of these cases at present offers very little promise.

Temporary Azoö-spermia. As stated before normal men may have periods during which they have no sperm. It has been found that some of these have sperm in the testicle and none in the ejaculated semen indicating a congenital occlusion of the duct. It is also quite likely that the production of sperm in the human male may be somewhat intermittent. The whole spermatic tubule does not function at one time and as will be stated later the quantity and quality of the sperm may vary under various conditions.

Azoospermia occurs during acute systemic infections and may persist for weeks after convalescence from long standing infections, such as typhoid fever

Any constitutional disturbance, as nephritis or diabetes and metabolic disturbances, may produce temporary azoospermia. Azoospermia with impotence and loss of libido which are permanent, has been seen in men who have passed through considerable mental and physical stress and privation and has been described among the recent war refugees of eastern Europe

Azoospermia due to Obstruction This is the most common cause for the absence of sperm and is due to obstruction in the epididymis or vas deferens as the result of occlusion of the lumen. Gonorrhea is the most common etiologic factor. Obstructive sterility will be discussed later in this chapter

Oligospermia Reduction in the number of spermatozoa in the ejaculated semen is of importance. Nature is very extravagant

Only one of the fifty to five hundred million spermatozoa that are present with each emission is necessary for fertilization of the ovum

Reduction in the number of the spermatozoa will reduce the degree of fertility in the male by lessening the percentage of possibilities for fertilization

Although theoretically the finding of only one spermatozoon in the specimen of semen on the slide, still allows for fertility in the male, the individual who shows only a few spermatozoa to the field is, as a rule, unable to fertilize the ovum. In old men, oligospermia with increase of amyloid bodies, markedly reduces the fertility of the individual. Oligospermia, as stated previously, is normal also at puberty

Reduction in the quantity and quality of the sperm results from excessive coitus. Horse breeders appreciate this in allowing certain intervals between mating

Asthenospermia This term indicates spermatozoa whose duration of life is very short and are usually only few in number. The finding of only a few active sperm among a large number, is an indication of lowered fertility and may be due to a variety of causes, systemic or metabolic. Under normal conditions about five to ten per cent of the spermatozoa will be found dead on the slide. The activity of the live sperm varies at times quite considerably. Those dying in the cervix and vagina are apparently advance guards and shock troops, preparing the way for the more virile and active spermatozoa

Necrospermia Spermatozoa may be destroyed by pus and bacteria, so that tails may be absent and the number reduced. As a rule, if necrospermia from infection occurs and this process is not of long standing, the sperm are normal although dead. We have occasionally examined fresh specimens of semen in which there was no history nor evidence of infection and in which only a few sperm were motile, these dying within ten or fifteen minutes

The degree of fertility and sterility is therefore dependent upon the presence or absence and the quantity and quality of the spermatozoa. It is also dependent, though to a lesser extent, upon the quality and quantity of the other constituents of the semen and the presence of extraneous substances, such as pus and bacteria

Methods of Obtaining Specimen of Semen

Puncture of the Testicle and Aspiration This procedure may be of value in determining the presence of spermatozoa in congenital azoospermia and proving the cause to be a congenital occlusion of the seminal duct. This test is, however, of no practical value because the procedure is one of hit or miss and the

failure to aspirate sperm does not necessarily indicate their absence. This procedure has been employed by many. Hühner claims priority. Aspiration of the testicle and direct injection of the aspirated spermatozoa into the uterus has been done successfully with resulting impregnation. The spermatozoa in the testicle are not motile but since they can become active in Ringer's solution this is likely to occur in the uterus also.

Puncture of the testicle is a very painful procedure. A few of our patients upon whom we have done it have fainted and shown symptoms of shock. We therefore do not recommend it. Puncture of the testicle may be supplemented with puncture of the epididymis or the epididymis alone may be punctured and aspirated. Puncture of the epididymis is not very painful but may give rise to considerable hemorrhage.

Prostatorrhea and Spermatorrhea. These are merely indications of a prostatovesiculitis and the occasional sperm present may help in determining the presence or absence of sperm.

Such specimens are otherwise of no diagnostic value. Belfield demonstrated by the examination of the urine of 100 men successively that spermatozoa are intermittently expelled normally from the seminal vesicles without ejaculation. He found that nineteen of these 100 had spermatozoa in their urine.

Expression of the Seminal Vesicles. This will often give practically all the desired information. Some of the casts of the vesicles consist of numerous sperm and mucus while others contain only mucus. The spermatozoa from the expressed secretions expelled into a glass held in front of the penis during massage may show normal motility and present all other findings of the normal ejaculated semen. Very often the casts of the seminal vesicles found in the third glass following massage appear like shreds of mucopus but will frequently be found to consist only of sperm and mucus.

The spermatozoa are killed in the urine of the third glass following expression. Occasionally a few active sperm can be found even in the acid urine. If the patient is impotent and does not want to masturbate this expression of the secretions of the vesicles and prostate may be the only method of procuring a specimen for diagnosis.

Condom Specimen. This is the generally accepted method of procuring a specimen of semen. It has its drawbacks however. The antiseptics and powder in the condom often kill the sperm and usually reduce their vitality. The round starch granules of the powder are often mistaken for corpora amylacea which are not round but somewhat square or hexagonal shaped. The semen should be examined as soon as possible preferably within the first two hours to determine the degree of motility of the sperm. When the specimen has been obtained the condom should be sealed or tied off to exclude the air and then transported in an inside coat pocket or inside a small bottle in which there is preferably some warm water to preserve heat. Semen can however be transported over long distances and over a period of twenty-four to thirty-six hours and still be motile.

Ejaculated Specimen. This is preferable to the condom specimen in that it is free from the antiseptic and powder of the condom. With coitus interruptus, the patient withdraws immediately before the orgasm and ejaculates into a small clean bottle which is sealed immediately and transported to the physician. A ready means of procuring the semen is to have the patient who may have in the past

practiced masturbation, repeat this so that the semen is entirely fresh. At times, the latter may be the only practicable procedure.

Examination of the Semen

It is possible in many cases to recognize by gross appearance, the absence of sperm or oligospermia. The semen with few or no sperm, often has the appearance of prostatic secretion, is small in quantity and liquefies quickly. However, many specimens which appear normal prove to have no spermatozoa on microscopic examination.

A hanging-drop specimen can be prepared on the slide or a drop of semen placed on the flat slide and covered with a cover glass. Under low power the quantity of mucus and pus can be determined and the numerous sperm can be seen. Extraneous substances can also be seen. Under high power, the spermatozoa can be seen clearly and the extent of their motility and variations in form can be determined. Some sperm move about faster than others and a large number are dead when the condom specimen is examined.

The presence of considerable mucus entangles the spermatozoa and destroys them. When a freshly ejaculated specimen is placed upon a slide the sperm will be found to have very little motility because the tenacious mucus has not as yet liquefied. After a few minutes on the slide, the spermatozoa increase their activity and motility markedly.

If the edges of the cover glass are sealed with vaseline to exclude air, the slide can be preserved and the spermatozoa, if quite active, remain alive twenty-four to thirty-six hours. The duration of life of spermatozoa on the slide is of importance in determining the vitality of the sperm and the degree of fertility of the individual.

MORE THAN ONE SLIDE SHOULD BE MADE. In fresh semen, only certain portions may show spermatozoa and other portions containing only prostatic secretion, not show spermatozoa. Giant forms, some with two heads, others with short or broken off tails, are some of the variations in quality which cause sterility.

FERTILITY AND INFERTILITY

Normal Variations in Degree of Fertility. The strong active man of twenty to thirty will show more active sperm with greater degree of activity than at any other time in life. Weak, anemic individuals or those who lead an indoor existence will show much less sperm and decreased activity of the spermatozoa. Some of these poorly nourished men present what has been described as one-child fertility. These weak anemic individuals are apparently stimulated during the first few months after marriage, to produce more active sperm than previously and are, at this period, able to fertilize the ovum. They then return to their previous state of infertility and are never thereafter able to fertilize the ovum.

Lowering of Fertility. Hard work, mental stress and strain due to absorption in business activities, together with lack of exercise, reduce not only the fertility of the individual but also his libido and potency.

It may be well to mention here that an individual² who is impotent is not necessarily sterile and that one who is quite potent may have congenital or acquired azoospermia.

² See also Chapter 23

Relative Infertility As has been stated in the opening chapter fertility and sterility should be studied in both the male and female and not only in one of the parties. It is a well known fact that a sterile couple may divorce and each marry again and develop progeny. In these cases the sperm of the male or the ovum of the female or both are weak in fertility. The mating of a man who has spermatozoa of relatively poor fertility with a woman who has excellent fertility may beget offspring. Fertility varies with variations in the state of health. Depressing environment, indiscretions in diet or lack of certain substances in the diet are also factors in reducing fertility and causing sterility.

Vitamin E discovered by Evans is an anti sterility substance found in wheat germ and lettuce. Experiments have shown that absence of Vitamin 'E' in the diet can reduce and destroy spermatogenic function.

Diet.

Errors in Diet Nutrition and Metabolic Faults Excessive quantity of food with lack of exercise producing cellular malnutrition and reducing the vitality of the sperm are common etiologic factors of lowered fertility.

Deficiencies of proteins, vitamins and mineral salts are the usual dietary errors also the absence of fats in the diet.

Vitamin E has been demonstrated to be essential in fertility. It is present in all fats except lard and cod liver oil. The oil in the grain of wheat contains this vitamin. The other vitamins, while necessary, are not as important. Diets low in calcium and phosphorus reduce the fertility of experimental animals and are very likely causative factors in reduced fertility. There should be an adequate supply of calcium in the diet.

Many stout individuals, although suffering partly from endocrine disturbances, may also have nutritional disturbances with a deficiency of proteins in the diet.

Starvation reduces the quantity of sperm in the semen and a full meal increases the number of sperm.

The Marital Habit. Irregularities in marital life may produce disturbances which will reduce the number of spermatozoa with each ejaculation and decrease the vitality of the sperm. Excessive coitus, prolonged practice of coitus interruptus with a resulting prostatovesiculitis and prolonged ungratified desire are factors in reducing fertility in the male.

Normally during coitus the semen is ejaculated as far up as possible so as to permit the spermatozoa to enter the cervix without encountering the acid vaginal secretion. A factor that may also aid considerably in the ascent of the sperm is the suction of the uterus during the relaxation following the orgasm.

DEFECTIVE PRODUCTION OF SPERMATOZOA

Developmental Failures. Absence of the testicle, cryptorchidism and in some cases failure of apparently normal testicles to produce spermatozoa, are etiologic factors in sterility.

Atrophy of the Testicle Following infections such as mumps, destruction from secondary infection within the scrotum or blood vessel or nerve injury, the testicle will atrophy and lose its spermatogenic function.

Tumors of the testicle, also chronic infections of the testicle, such as syphilis, hydrocele due to chronic infections of the epididymis, are all etiologic factors in the production of azoospermia

Endocrine Failure and Endocrine Disturbance Decreased thyroid secretion with low basal metabolism may be one of the factors in infertility. Froelich's syndrome of hypogenitalism with absence of spermatogenesis is an example of the allied endocrine failure affecting spermatogenesis. Hypogenitalism³ due to failure of the internal secretion of the testicle will cause sterility. Obesity is often an evidence of endocrine disturbance but in many cases it is due merely to dietary indiscretions and may produce various degrees of infertility.

Intoxications and depressed constitutional states The defective production of spermatozoa or the production of abnormal or partly formed spermatozoa, is due to either systemic or local causes.

Chronic alcoholism decreases the quality of the sperm to a large degree, the chronic alcoholic being often sterile.

Acute and chronic infections and a debilitated condition due to nephritis and diabetes, either destroy the sperm or lessen their vitality. With chronic intoxications, the spermatozoa may reappear if the cause is removed. Other intoxications as chronic lead poisoning, morphinism and in some cases, excessive use of tobacco, affect spermatogenesis and fertility, unfavorably.

In the development of the generative cells, the process is one of division rather than a multiplication as in the somatic cells. With the degeneration of the epithelium of the seminiferous tubules, restoration of function is still possible, if the spermatogonia have not been destroyed and the Sertoli cells are still present. If the latter are destroyed, regeneration is not possible.

Injuries to the testicle from various causes will, of course, affect spermatogenesis. Sterility from prolonged use of the x-ray is well known. During x-ray therapy, the testicles should be protected to prevent injury to the seminiferous tubules.

HOSTILITY IN THE SEMINAL DUCT

The classification of obstruction and hostility in the male passages covers another large group of etiologic factors in sterility.

Epididymis A spermiphage is presumed to be present in the epididymis under certain states of toxemia. The secretion of the epididymis may be absent or a chronic infection of the epididymis may destroy the sperm.

Prostatovesiculitis, Acute and Chronic This is a frequent cause of infertility and sterility. The excessive mucus and pus diminish the vitality of the sperm and in many cases kill them. The inflammation may interfere with the normal secretion of the prostate, vesicles and ampullae which activates the spermatozoa.

The cure of a prostatovesiculitis of infectious origin, either acute or chronic, will restore the individual to normal. Chronic prostatovesiculitis due to coitus interruptus, excessive coitus and prolonged use of condoms, which are all etiologic factors in reducing fertility, can be cured by eliminating the cause. This subject has been fully covered under Chapter 19 on vesiculitis.

³ See Chapter 21

Necrospemia and variations from the normal in the shape of destruction of the tail and reduction of motility, are commonly seen with chronic vesiculitis.

Obstructive sterility in the male. Bilateral epididymitis is the most common cause of obstruction of the ducts and is usually gonorrheal in origin. The inflammation persists in the tail of the epididymis and occludes the duct. Strictures of the vas deferens either in its scrotal or pelvic portion may also occur. Those in the epididymis and in the scrotal portion of the vas can be shortcircuited or resected. The pelvic portion of the vas is inaccessible. Strictures of the ejaculatory duct are rare and require dilatation.

The treatment of obstructive sterility is taken up under operations for sterility in Chapter 51.

FAULTS OF DELIVERY

Impotence. The patient who is impotent because of inability to have a proper erection and ejaculation or inability to have coitus because of gross abnormalities or growths is classified according to the classification of Meeker under cases of sterility due to faults of delivery and reception.

Failure to deposit the semen far enough up into the vagina or only a weak ejaculation may be factors that influence impregnation. Premature ejaculation at the time of insertion minimizes the possibility of fertilization.

Thus impotency with rapid ejaculation or the failure in intromission may be the cause of sterility even though the semen may show numerous live sperm.

Malformations of the genitalia such as hypospadias because of failure to deposit the sperm in the vagina, may be a cause. Although it is possible to impregnate by the deposit of semen on the vulva, this is not common and is more likely to occur in a virgin than in the married woman with actively acid vaginal secretions that will destroy the sperm on their way up.

Tumors of the penis, abnormally short penis, gross pathology such as hydrocele or hernia interfering with coitus may be causes. Tight strictures of the urethra may permit only a weak ejaculation and in some cases no semen presents itself at the meatus but flows back into the posterior urethra and bladder.

TREATMENT

The causes of Sterility are Many. The male is at fault in at least one-third of the cases and it is therefore necessary to examine the male as well as the female. In the past the female was subjected to much treatment and even operative interference but no attempt was made to examine the semen of the male.

The various causes and etiologic factors outlined indicate that the treatment consists in removal of these causes. Dietary and metabolic disturbances, abnormalities and infections of the genitalia require correction. Endocrine disturbances such as thyroid insufficiency may be affected favorably as we have noted in a few cases with thyroid therapy.

Surgical interference for obstructive sterility is outlined in Chapter 51.

The treatment of impotency and the sex neuroses is covered in Chapter 23.

The correction of defects in sex habits, proper exercise, diet and elimination of mental stress will improve many cases of lowered fertility. Obesity is an

important cause in the female, particularly, also in the male Reduction of weight will improve the fertility

The various experimental efforts to increase virility or delay senility and cause rejuvenation by means of testicle transplantation have proven of no value

Spermatogenesis does not cease with occlusion of the duct Fifteen to twenty years after occlusion of the epididymis following epididymitis, spermatozoa will still be found in the head of the epididymis Although some claims of the rejuvenating qualities of vas ligation, or the Steinach operation, have been set forth, it is difficult to attribute any results to this procedure

STERILIZATION OF THE MALE

This is simple and can be done as an office procedure The scrotal vas is pulled out through a small incision, about one and one-half inches being exposed and the vas ligated at each end of the exposed area of the vas Resection of at least one-half inch of the vas is then made and the cut ends apposed laterally, overlapping each other in order to prevent restoration of the lumen that may occur, as one of us has shown If the cut ends are apposed or allowed to drop back in the sheath, the vas will regenerate and the lumen be restored

CHAPTER 23

SEX NEUROSES

MASTURBATION
POLLUTION
IMPOTENCE
ORGANIC CAUSES

FUNCTIONAL CAUSES
PSYCHIC CAUSES
PSYCHOPATHIA SEXUALIS
PATHOLOGIC ERECTIONS

Normal sex function varies considerably with different individuals for aside from variations in general constitution and physical variations in the sex organs sexuality and virility are influenced by a number of factors some of which are difficult to evaluate. The internal secretions of the various endocrine organs are important in affecting sexuality but of particular importance are the various nervous and psychic factors.

Sexual life in the male begins between the ages of fifteen to seventeen years. Sexual ability reaches its height at the age of twenty five years after which it remains stationary for a few years and then gradually declines. There is a noticeable decline in most men past forty and at fifty five many men have very little sexual desire. However each individual is an index unto himself. Virility and sexual longevity may vary within wide limits. In some individuals unusual virility is an inherited characteristic. Some men may be able to have coitus daily over a period of years and others equally as vigorous and often more so may have coitus only on rare occasions. Both may be equally potent.

The physiology of erection and ejaculation is not as yet well understood. It can readily be seen therefore that many of the pathologic conditions may offer considerable difficulty in diagnosis and therapy.

MASTURBATION

The vast majority of men have masturbated during their early adolescence. When the youth reaches the end of the adolescent period and becomes definitely heterosexual he discontinues the habit. However some continue to masturbate for many years after reaching adult life. When not carried to excess masturbation does no harm. However when persisted in over a long period of time chronic congestion of the prostate and seminal vesicles develops as well as damage to the nervous system and psychic disturbances resulting in sexual neuroses which may markedly affect the life of the individual and may be a more serious sequel. It is at times difficult to determine whether the psychic and neurotic disturbances are not in fact the primary cause for the continuation of the habit. This is undoubtedly the case in most instances. Young men who masturbate to excess over a long period of time usually give a history of a neurotic inheritance. When masturbation is carried to excess a vicious circle develops. The irritation in the posterior urethra as the result of the chronic congestion which develops leads to further masturbation.

Some of the advanced cases can be improved by proper sexual hygiene and abstinence. Others require direct treatment. Prostatic massage and topical applications of a mild solution of silver nitrate through an endoscope or instillations into the posterior urethra may be of considerable value. However most of these

individuals suffer from a rather marked psychosis or sexual neurasthenia for which little can be done

The occasional masturbator does no damage to himself nor his sexual organs. Neither does the youth suffer as the result of the practice during adolescence. Much has been written about the dangers of masturbation, very little of which has any basis.

POLLUTIONS

Involuntary nocturnal emissions occur in most normal men who are continent or who have had prolonged periods of abstinence. Emissions may follow prolonged ungratified sexual excitement, and are usually associated with erotic dreams. They are common in the adolescent and in young men, and may occur, normally, as frequently as once a week, or even oftener.

However, when emissions occur as frequently as 2 to 3 times a week or oftener, the condition is pathologic, and usually indicates some abnormal condition in the prostate, seminal vesicles and verumontanum. During the course of acute gonorrhea, nocturnal emissions indicate an infection of the seminal vesicles. Some irritative lesions of the spinal cord may be responsible for frequent emissions. Diurnal pollutions are always pathologic and are usually associated with some form of masturbation. Some individuals who are highly neurotic may have an emission on the slightest contact with the opposite sex, as when dancing. Prostatorrhea and spermatorrhea are due to a chronic congestion of the prostate and vesicles, usually in highly neurotic individuals, and often clear up when the prostatovesiculitis subsides. When involuntary emissions are due to some pathology in the prostate, seminal vesicles or posterior urethra, abstinence from sexual activity or excitement, a bland diet, avoidance of alcohol, local treatment to the prostate and vesicles in the form of massage and instillations of mild silver nitrate solution to the verumontanum will help the majority of cases.

IMPOTENCE

Potency is dependent upon the following factors, libido, erection, ejaculation and orgasm (Beilin). These factors are, however, not equally concerned in the causation of impotence. Impotence signifies inability to copulate normally (Herman, page 686, *Practice of Urology*, 1938, Saunders), and may vary considerably in degree from that of premature ejaculation to total inability to have an erection. The causes of impotence are many, and may be divided into the classification of Organic, Functional and Psychic causes.

ORGANIC CAUSES

The organic causes of impotence may be classified as follows: 1. Local pathology of the genitalia, congenital or acquired. 2. Impotence due to systemic disease, acute or chronic. 3. Diseases of the nervous system. 4. Endocrine disturbances.

(1) Under local pathology of the male genitalia are included all malformations or acquired abnormalities due to ulceration, destruction, inflammations or swellings, that make coitus very difficult or impossible. Among these may be

mentioned curvature of the penis in marked hypospadias extensive ulcerations of the penis curvature of the penis due to plastic induration of the corpora cavernosa and a large hernia or hydrocele which renders coitus difficult. Ulcerations or granulations in the deep urethra as the result of gonorrhea and strictures of the urethra may be the cause of impotence.

(2) **Impotence Due to Acute and Chronic Systemic Disease** Chronic alcoholism anemia chronic intoxication due to lead and morphinism are causes of impotency. Chronic infections which reduce the vitality of the patient are frequently associated with impotence.

(3) **Diseases of the Nervous System.** Under this can be included all organic diseases of the brain and cord. Patients with tabes are impotent. Injuries to the cord resulting in some degree of bladder paralysis are usually associated with impotency. In marked peripheral nerve involvement as in polio-myelitis impotence may also result.

(4) **Endocrine Disturbances.** In those with congenital endocrine disturbances as is seen in various types of Froehlich's Syndrome impotence is common. Acquired hypo-thyroidism may result in impotence due to lowered metabolism. Failure of normal development of the testes and non-descent of the testes led to reduced libido and impotence. The castrate has a reduced libido and is frequently impotent.

FUNCTIONAL CAUSES OF IMPOTENCE

Masturbation, excessive coitus and continued practice of coitus interruptus are the chief causes. The functional types of impotence are common but are usually associated with psychic disturbance which make their treatment difficult. Masturbation practiced to excess over a prolonged period causes a chronic irritation of the adnexa and of the centers in the spinal cord. The sequence of events is rapid ejaculation followed later by difficulty to obtain erection and finally inability to have erection. With continued practice of coitus interruptus and excessive coitus ejaculations may be premature and occur at time of intromission later only upon semi-erection and finally no erection is possible nor ejaculation.

Physiologic impotence is present before puberty and in the old. Prolonged ungratified sexual excitement and irritation may reduce potency. The use of condoms over many years is also often a cause for reduction of potency. The treatment of functional impotence aside from the resumption of normal sexual life consists of massage of the prostate and vesicles, and local treatment to the verumontanum by the application of 5 per cent silver nitrate through the endoscope or instillation of mild silver nitrate solution $\frac{1}{4}$ to $\frac{1}{2}$ per cent into the posterior urethra. Some men past fifty are impotent because of physical and mental strain and a vacation is often all that is necessary to cure the condition. A man of fifty who has discontinued sexual activity because of death of his wife often becomes impotent if the abstinence continues for a period of 2 years. Internal medication to promote or improve erections is of very little value. yohimbine and strychnine are the most frequently used. Antultrin S has been recommended as having considerable merit—it is very questionable whether it has much effect in aiding the power of erection. Passage of a cold sound is an old

practice, and in some cases helps to promote a temporary erection. A diet rich in proteins may be of help in aiding potency.

PSYCHIC CAUSES OF IMPOTENCY

Most cases of functional impotence, as stated previously, have a psychic or neurotic basis. Many are of purely psychic or neurotic origin. These patients who are impotent are frequently young men who have had very little sexual life, usually give a history of familial neuroses, and show evidence of psycho-neurosis. The individual who has had an unhappy sexual experience or because of fear of becoming infected may be temporarily impotent over a period of time. Fears, repressions and inhibitions may be included here as causes of temporary impotence. These are usually overcome, although many months and even years may elapse before the patient returns to normal. However, many of the patients with psychic impotence are difficult to treat. They usually require the attention of a psychiatrist who very often can help but little. These are the people who frequently go from one urologist to another seeking aid, and for whom, unfortunately, very little can be done in most cases.

The operative treatment for impotence offers very little. When the perineum has been damaged as the result of trauma, the Lowsley operation of plication of the bulbo-cavernosus muscle, and shortening the ischiocavernosus muscle may be of some help. It is not indicated for any other type of impotence. Testicular transplants, the Steinach operation, and the injection of testicular extracts are of no value.

PSYCHOPATHIA SEXUALIS

Perversions of the milder degree are acquired and can be stopped with very little difficulty in the majority of cases. Most of the acquired perversions cannot be classified as pathologic. However, homosexuality, and the pathologic perversions of the psychopaths with sadistic and masochistic tendencies should be treated by the psychiatrist who can offer hope for improvement in only few cases.

PATHOLOGIC ERECTIONS

Transitory Erections Any irritation of the urethra may be the cause of recurrent transitory erections, such as occurs during the course of acute gonorrhea when the posterior urethra is involved. Polyps, warts and urethral stricture may be the cause of these transitory erections. Chronic congestion of the prostate and vesicles are also etiologic factors, prolonged or exhausting coitus, and prolonged ungratified sexual excitement can lead to prolonged erections which subside within 10 to 30 minutes, and usually not longer than an hour. Various diseases of the spinal cord, such as tumors, and in early tabes may also lead to frequent prolonged erections. An interesting and unexplainable form of chronic recurrent erection is the individual who experiences these erections at a certain definite time each day. The erection usually occurs at night, often awakening the individual, lasts a short period of time, and then subsides. This may recur nightly, appearing at the same hour each night over a period of many months or years, and not be influenced by sexual activity or any medication.

Priapism. True priapism is a remarkable condition of prolonged and persistent erection, with sudden onset, unaccompanied by sexual desire, and usually painful (Hinman.) The erection in true priapism continues for many days and frequently many weeks. It is commonly the result of cerebrospinal syphilis. Leukemia is the next most frequent cause. Injury to the brain or spinal cord may also be causal factors. After the erection has persisted for a few days thrombosis of the corpora cavernosa develops which maintains the erection irrespective of the original etiologic factor. Neither general nor spinal anesthesia has any effect in reducing the priapism. If it has persisted for a week or more and if painful the most satisfactory treatment consists in puncturing the corpus cavernosum of each side. Dark thick blood is aspirated, and very often relief occurs rapidly after this. In other cases incisions into the corpora cavernosa are necessary. No thrombosis is found but considerable dark thick blood is removed after which there is relief of the symptoms. Treatment of a cerebrospinal syphilis does not affect the priapism once it has become established. In some cases the priapism will subside after a few days only to recur again. After an individual has had a prolonged priapism and is finally relieved he is usually impotent.

RECURRENT PRIAPISM may be treated surgically by ligating the dorsal arteries of the penis. It has been of value in some cases. Many patients who have had perineal operations particularly perineal prostatectomy are impotent therefore division of the ischio-cavernosus muscle together with the blood and nerve supply of these structures is also recommended for these persistent erections.

Priapism may also occur in carcinoma of the penis.

PART FOUR

BLADDER

CHAPTER	PAGE
24 ANOMALIES AND INJURIES OF THE BLADDER	451
25 CYSTITIS AND PERICYSTITIS	462
26 BLADDER, DIVERTICULA HERNIA CALCULI FOREIGN BODIES	480
27 TUMORS OF THE BLADDER	504
28 NEUROGENIC DYSFUNCTION OF THE BLADDER	519

ORIENTATION

This portion of the urinary tract not only serves as a temporary storehouse or reservoir for the urine but also acts like the governor of an engine in regulating the secretory activity of the kidney. This latter reflex function has been demonstrated with the aid of excretory urography. When the bladder is full, less urine is found in the renal pelvis and vice versa.

Anomalies of the bladder, such as double bladder, are very much rarer than either those of the urethra or upper urinary tract. An injury of the bladder may involve either the upper portion which is in more or less intimate relation with the peritoneum or the rupture may occur where the outer wall of the bladder is only in contact with the loose cellular tissue of the true pelvis. In the majority of cases, bladder injuries are of subparietal origin, i.e., due to a nonpenetrating force, which not only causes a rupture of the bladder, but also a fracture of the pelvis, most commonly at or near the pubic symphysis. Aside from the inability to urinate, the signs of a bladder injury are either those due to an infiltration of urine into the perivesical tissues or those of peritonitis, the former corresponding to the extra- and the latter to the intraperitoneal form of injury.

Cystitis is very rarely a primary condition, but has its origin in an infection in some portion of the urinary tract proximal to the bladder, or in the urethra and some component of the seminal duct such as the epididymis, seminal vesicle, etc. The first task in every case of cystitis is to search for a primary extravescical focus. In the majority of cases, such a source is an infection of the kidney.

The student should be impressed with the extreme rarity of a primary cystitis and taught to look out not only for foci of infection in other portions of the urogenital tract but also learn to appreciate the important part played by any form of obstruction at the bladder neck or in the urethra to persistence of a bladder infection. A bladder diverticulum may be thought of as a herniation of the wall like the finger of a glove in relation to the hand proper portion. Although very large diverticula are found in children without demonstrable obstruction at the bladder neck, the majority are found in adults associated with some such obstruction. Their diagnosis with the aid of cystoscopy and cystography presents no difficulties.

Next to cystitis, the two bladder conditions, most frequently seen, clinically, are calculi and tumors, in about equal proportions. Although the various theories are evaluated in Chapter 26 regarding the formation of urinary calculi in general, it will be seen that the theory which best explains their formation is one which takes into consideration a combination of stasis due to some form of obstruction plus a superadded infection either from a source external to the body or to bacteria reaching the bladder from an infected prostate, seminal vesicle or epididymis in the male and from the upper urinary tract in both sexes.

CHAPTER 24

ANOMALIES AND INJURIES OF THE BLADDER

ANOMALIES

COMPLETE ABSENCE (APLASIA)
DOUBLE BLADDER
EXTROPHY (ECTOPIA VESICÆ)
AFFECTIONS OF THE URACHUS

INJURIES OF THE BLADDER

WOUNDS
RUPTURES
SPONTANEOUS RUPTURE

ANOMALIES

COMPLETE ABSENCE (APLASIA)

Very few cases have been reported in the living because the anomaly is usually accompanied by others which are incompatible with life. In those cases which have lived the ureters ended in a pouch representing the proximal end of the urethra.¹ Incontinence was a prominent symptom and death occurred as the result of ascending infection (pyelonephritis)

DOUBLE BLADDER

Although many of the earlier reported cases have been shown to be diverticula as large as the bladder itself yet this anomaly has been observed often enough to enable one to speak of two varieties (a) Complete i.e. two separate bladders (Figs 299 and 300) (b) Incomplete, i.e. two compartments separated either by a septum in the sagittal or in the coronal plane

The complete are more common. A typical case of this type has been described by Trinkler (*Zeit. f. Urol.* 1912 7 751). There were two completely separated bladders (Fig. 299) each with a urethra. There was one kidney and ureter for each bladder and two separate vaginal and rectal orifices. At laparotomy two separate uteri with a broad ligament tube and ovary on each side were found. A similar case in the female reported by Schatz (cited by Cathelin and Sempe in *Ann. des Mal. des organ. gen. urin.* 1903 I 339)

In the incomplete variety also termed vesica bipartita there was an anterior and a posterior bladder in the case reported by Cathelin and Sempe, the septum being in the coronal plane. In the case of Juetting² the bladder was divided as in the preceding case into two communicating cavities but the septum was anteroposterior i.e. in the sagittal plane. In neither of these incomplete forms was the trigone involved

EXTROPHY (ECTOPIA VESICÆ)

This occurs a little more frequently than do the preceding two anomalies and is about eight times more common in males than females. There are two forms

Complete Cases.

There is an absence of development of a portion of the lower anterior abdominal wall in the midline so that there is a protrusion through the defect, of the posterior wall of the bladder. This is possible because there is an accompanying absence of development of the anterior wall of the bladder

See Chapter I on development of bladder and urethra.
Cited by Schwartz. *Beitr. z. Klin. Chir.* XV 1895 159

Complete Exstrophy³ in the Male (Fig 301) One sees a reddened, uneven, easily bleeding protrusion and upon lifting it, the ureteral orifices and the ligament (interureteric) joining them, become visible. There is a sharp line of demarcation between the red epithelial lining of the protruding posterior wall of the bladder and the adjacent skin. Upon reduction of the protrusion, a firm edge like that of a hernial ring can be felt beneath the line of demarcation.

FIG 299

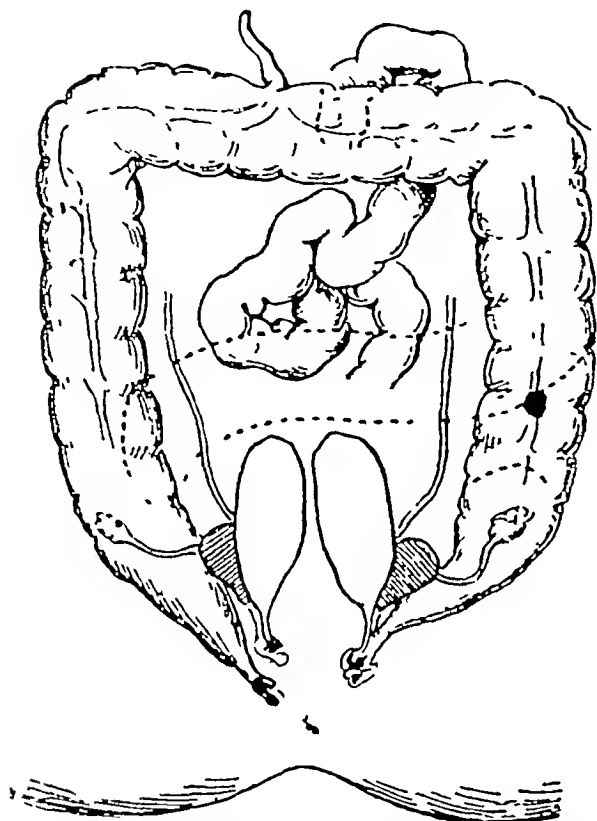


FIG 299—Unusual case of complete reduplication of the bladder and of the internal genitalia in the female. Each bladder received the ureter of the corresponding side. Case reported by N. P. Trinkler in the *Zeitschrift für Urologie*, 1912, 7, 751.

FIG 300

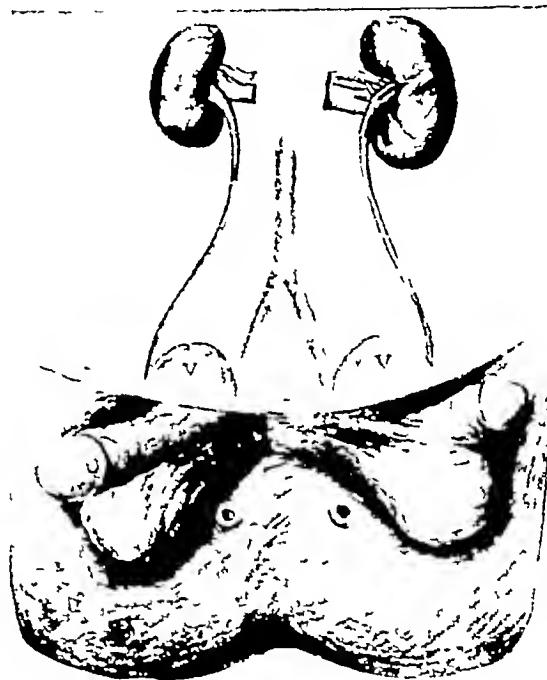


FIG 300—Unusual case of anomaly of the bladder and of external genitalia published by Dr. C. Bruni of Naples, Italy, in the *Zeitschrift für Urologie*, 1927, Volume 21, page 193 (March).

There was reduplication of the penis and of the bladder (V) as well as complete division of the scrotum and two separate anal openings. Each bladder received the ureter of the corresponding side.

A COMPLETE EPISPADIAS USUALLY ACCOMPANIES THE BLADDER EXSTROPHY, the penis being greatly shortened, and flattened transversely. The upper urethral wall is entirely absent so that the epithelial lining of the lower urethral wall is seen to be continuous with that of the bladder. Cryptorchidism, spina bifida, harelip and clubfoot, frequently accompany this anomaly of the bladder. Absence of the symphysis pubis with wide separation of the pubic bones, is constantly found in cases of exstrophy, of this complete variety, in both males and females.

Complications of Exstrophy of the Bladder

CARCINOMA Judd and Thompson (*Arch Surg*, 1928, 17, 641) could only find 18 reported cases, to which they added two. Twelve of the 20 patients were men and 7 women, the sex not being mentioned in one report. The youngest patient was 23 years of age, the oldest 66. The average age was 50.

³ Exstrophy in the female is discussed in the chapter "Urology in the female."

Scheuer (Zeit Urol Chir 1930 30 299) reported a case in a man 38 years of age so that only 21 observations are on record

EFFECT ON UPPER URINARY TRACT Ureterectasis and pyelectasis is a frequent finding as the result of obstruction to the escape of urine into the bladder. If infection supervenes it plays an important part in determining the outcome of an operation. The degree of ectasis of the upper urinary tract can usually be visualized by excretory urography. This method should invariably be employed before any operative procedure is undertaken.

INTESTINAL COMPLICATIONS In addition to 12 cases reported by others we have observed one in a newborn male infant in which there was a communication of the small intestine through an opening in the posterior wall of the bladder and an accompanying absence of the rectum.



FIG. 301.—Exstrophy of the bladder associated with complete epispadias and bilateral nondescent of the testes.

Incomplete Cases.

In these there is only a defect of the upper or lower portion of the bladder wall. The symphysis pubis is united and there is no accompanying epispadias.

Etiology

The most generally accepted view is that there is a forward displacement or extension of the cloacal membrane (Fig. 4 of Chapter I) so that the mesoderm fails to develop the abdominal wall between the genital tubercle and the umbilicus.

Clinical Aspects

The constant wetting of the clothing and the tendency for the exposed epithelial lining of the posterior bladder wall to bleed are the outstanding symptoms. Inspection of the protrusion and observation of the urine being ejected at intervals from the ureteral orifices makes the diagnosis comparatively easy.

Treatment

Of the three methods (a) plastics, (b) transplantation of the trigone into the rectum and (c) re-implantation of the ureters into the sigmoid or rectum, only the last named is employed by the majority of urologists at the present time. The preparation of patients and technic of the most frequently employed methods is discussed in Chapter 52.

AFFECTIONS OF THE URACHUS

Although these are not, strictly speaking, anomalies of the bladder, the close embryologic and clinical relation of the urachus and bladder make it advisable to consider them here.

Cysts of the Urachus.

These are the result of the persistence of a portion or all of the lumen of the urachus (see Chapter I). The majority are found in close proximity with the apex (dome) of the bladder. They may be quite small, or large enough to have a capacity of 20 to 40 liters of fluid. The latter is usually clear and of a yellowish tinge like that of a hydrocele but it may be bloody or even purulent.

Clinically, one notices a prominence in the midline between the umbilicus and pubis. But few symptoms are present, unless there is considerable displacement of adjacent (intrapertitoneal) viscera or unless acute infection supervenes.

Treatment consists in making an incision in the median line over the mass and enucleating it from the separated recti muscles and from the peritoneum.

Umbilical Urinary Fistulae TRUE CONGENITAL FISTULAE in which urine is discharged from the umbilicus, and acquired fistulae of the same nature, are confused in the literature, according to Begg (*Surg Gynec and Obst* 1927, 45, 165). Congenital fistulae are of two varieties, (a) the cases in which urine flows freely or exclusively from the umbilicus, and (b) those in which the urine flows drop by drop.

ACQUIRED FISTULAE are also of two types, (a) the bladder apex is at the umbilicus, the urachus being absent, and (b) the urine escapes through the dilated terminal centimeter of the urachal canal or through the weak point at the junction of the urachus with the bladder. The urine bursts through the weak point formed by the depression in the lowermost portion of the umbilicus.

If infection occurs, the discharge from an umbilical fistula may become purulent instead of clear.

The existence of a patent urachus should be thought of in every case in which (a) there is a constant or intermittent discharge of clear or purulent liquid from the umbilicus or from a sinus located in or near the median line between the pubic symphysis and the umbilicus and (b) if a cystic or solid mass is felt in or near the median line between the bladder and the umbilicus.

Complications of Urachal Fistulae and Cysts Cases have been reported of calculus formation, of carcinoma and of sarcoma (Ransom, *Am Jour Surg*, 1933, 22, 187). A carcinoma situated at the vertex of the bladder must always be suspected to be of urachal origin.

Diagnosis The two best methods are cystography and cystoscopy. In the former, a finger-like extension at the vertex of the cystogram has been found in several cases in which operation confirmed the diagnosis of a persistent urachus.

Treatment is surgical, i.e. extirpation of the entire tract or cyst as the case may be. This is often very difficult owing to the presence of adhesions to the adjacent muscles and peritoneum, which latter may have to be opened in one or more places.

INJURIES OF THE BLADDER

These can be divided into two principal groups

1 Wounds i.e., those due to some penetrating force

2 Ruptures also termed subparietal or subcutaneous injury, i.e., due to increased intravesical pressure as the result of a force acting from without or within

Although they differ but little in respect to diagnosis and treatment, it is desirable to consider them separately because of the difference of their mode of origin

WOUNDS

1 These can be caused by the penetration of any of the following

(a) Objects which penetrate from without, such as shell fragments rifle and machine gun bullets, bayonets, knives spikes horns of cattle pitchforks etc. scalpels (during laparotomy herniotomy etc.) splinters of a fracture of the pelvic bones sequestra following an osteomyelitis of the pelvic bones etc.

(b) Objects which penetrate from within, such as the beak of a cystoscope the jaws of a lithotrite the tip of a sound etc.

Pathologic Anatomy of Penetrating Wounds

Wounds due to bullets daggers, bayonets etc. are as a rule clean cut. If the force acts from above there may be only a wound of entrance but more often there is both one of entrance and of exit. In wounds due to shell fragments or the fragments of a fracture the wound is almost always irregular i.e. with lacerated edges. There may be a single or multiple wound in such cases. There is no rule as to whether the wound involves that portion of the bladder which is not covered by peritoneum i.e. is extraperitoneal or is located in the portion covered by the peritoneum (Fig 37) i.e. is intraperitoneal in the case of penetrating objects acting from without. There is only one exception and that is penetration from below (through the perineum rectum or vagina) usually involving the extraperitoneal portion e.g., the base or posterior wall of the bladder. The more clean cut a perforation is the less apt is one to find extravasation of blood devitalization etc. of the perivesical tissues. If the perforation involves the intraperitoneal portion (Fig 303) urine escapes into the peritoneal cavity. If the urine remains aseptic, it gives rise to a less severe reaction on the part of the peritoneum than if it is infected. The latter often occurs as the result of catheterization. One must never overlook the possibility of perforations of the other abdominal viscera in cases of perforating injuries of the bladder involving its intraperitoneal portion.

If the perforation involves the extraperitoneal portion alone or such an injury coexists with one of the intraperitoneal portion urine escapes into the

perivesical and perirectal tissues and from these toward the anterior abdominal wall and perineum. The severity of the cellulitis (pelvic) which follows such an extraperitoneal wound, depends on the degree of infection of the escaping urine. In wounds due to penetration of fragments from a fracture of the pelvic bones, there is not infrequently an associated rupture of the posterior urethra.

Penetration of the bladder during instrumentation (passage of sound, cystoscope, inclusion in grasp of jaws of lithotrite), is uncommon. It is most likely to occur when the wall is the seat of some pathologic condition, such as atony of long standing, urethral or vesical neck obstruction or some neurologic condition, also in carcinoma, tuberculosis, etc. Penetrating wounds, whether the force acts from within or without, are more likely to occur when the bladder is full.

In the case of bullets, shell fragments or splinters of bone, they may remain in the bladder and form the nucleus of a calculus. The gravity of a bladder wound depends (a) Upon the extent of the accompanying injuries e.g., of the blood vessels, other abdominal viscera and of the bony structures (b) Upon the degree of infection of the peritoneum or perivesical cellular tissue or both.

Symptoms and Diagnosis of Penetrating Wounds

The symptoms of bladder wounds arising from without, i.e., through the abdominal wall, perineum or rectum, do not differ in any essential respect from those in which there is an injury (rupture) of the bladder without external evidences. For this reason we will consider them in conjunction with rupture of the bladder.

In addition, however, to the symptoms which are common to both modes of injury, there are certain points which are of value in connection with the diagnosis of penetrating injuries. Of great value is the examination for a wound of entrance. If this is located over the bladder region, the symptoms of an injury of this viscus must not be watched for, too long. It is far better to perform an exploratory operation as outlined below, than to wait for symptoms of peritonitis from an intraperitoneal perforation of the bladder or the presence of extravasation and subsequent infection in the loose cellular tissue around the bladder, from a perforation located in its extraperitoneal portion.

Treatment

This differs so little in penetrating injuries from that which should be employed in those due to a non-penetrating force (ruptures), that it will be considered in connection with the latter. There are a few special features, however, of penetrating injuries (wounds) which need to be emphasized. Aside from stab wounds or those following impalement on the horns of cattle and similar modes of injury, the bladder is seldom the only abdominal structure involved. Hence, in wounds by shell fragments, rifle or machine gun bullets, etc., not only may the symptoms of injury of other abdominal viscera and large blood vessels predominate, but on the other hand, even though one suspects or has found at operation, a bladder wound, a most careful search should be made for damage to surrounding structures. This is also true of bladder injuries complicating fractures of the pelvis, owing to the not infrequent association of bladder and urethral wounds.

RUPTURES OF THE BLADDER (SUBPARIETAL OR SUBCUTANEOUS INJURY)

Etiology and Mechanism. Rupture of the bladder as a rule occurs when the viscus is full. The only exception is when the bladder is torn in connection with a fracture of the pelvis and in those cases where there is a tear as the result of dislocation of the pubic bones at the symphysis pubis. The injury may occur in one of the following ways

(a) Direct force exerted from without over the bladder region e.g. a kick, blow, fall astride a fence, crushing injuries or some object falling upon the lower abdomen from a height.

FIG. 302



FIG. 302—Necropsy specimen from a case of intraperitoneal rupture of the bladder. Note perforation at vertex of the bladder.

FIG. 303

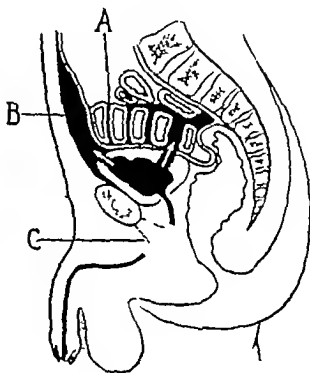


FIG. 303—Traumatic rupture of the bladder. A Escape of urine into peritoneal cavity in intraperitoneal rupture. B Same into pre- and perivesical spaces in extraperitoneal rupture. C Rupture of membranous urethra.

(b) Indirect force acting from without i.e. a sort of contrecoup action of the force e.g. fall on back or on legs.

(c) A direct force exerted on the wall of the bladder from within as might occur during excessive filling of the bladder. This usually occurs when there is some pathologic change in the wall such as tuberculosis, carcinoma, atony or as a sequel of bladder neck or urethral obstruction.

Intraperitoneal ruptures (Fig. 302) occur in about two-thirds and extra-peritoneal in the remaining third. The majority of ruptures in both instances involve the entire wall and are longitudinal. Incomplete rupture involving only a portion of the thickness of the wall occurs very seldom. The chief complication of the intraperitoneal variety is escape of urine into the general peritoneal cavity.

while the chief complications of the extraperitoneal form are extravasation of urine into the perivesical, perirectal and subcutaneous tissues, as well as injuries of other abdominal viscera, large blood vessels and rupture of the urethra. One must constantly bear in mind, the latter complication.

Symptoms and Diagnosis

These vary according to whether the case is seen early (first 24 hours) or at a later period.

1 Early Cases (first 24 hours)

(a) **SHOCK** This is transitory and usually more marked in cases of rupture, especially those complicating a fracture of the pelvis, than in wounds of the bladder.

(b) **LOCAL PAIN** Usually referred to the lower portion of the abdomen. It is not a prominent symptom, except in cases complicated by pelvic fractures or similar crushing injuries.

(c) **INABILITY TO URINATE** The patient has a constant desire to urinate but is able to void only a few drops of blood or a small quantity of bloody urine with much effort and pain. There may be a complete absence of subjective symptoms if, as frequently occurs in ruptures of the bladder, the patient is intoxicated.

(d) **RIGIDITY OF THE ABDOMINAL MUSCLES AND TENDERNESS ON PRESSURE OVER THE LOWER ABDOMEN** This is an objective symptom to be constantly looked for both in wounds and ruptures of the bladder. If the area of muscular rigidity is increasing from hour to hour and is accompanied by a progressive increase in the pulse rate, a steadily rising leukocytosis and nausea, or vomiting, it indicates a beginning peritonitis and no time should be lost, whether or not the above subjective symptoms are present. The more infected the urine has been before the accident, the more rapidly do the symptoms of peritonitis develop.

(e) **EVIDENCE OF PERIVESICAL INFILTRATION** These are usually not very marked during the first 24 hours. Locally, there is a brawny infiltration of the subcutaneous tissues and skin over the lower abdomen (suprapubic region) or at least, a sense of resistance which is more superficial than is that of a distended bladder (Fig. 173). Even when there are but few local evidences of extravasation of urine into the cellular tissues around the bladder, one should have the pulse rate and temperature (preferably per rectum) taken every two hours and leukocyte count made at the same interval. A progressive rise in the pulse, temperature and leukocyte count should make one very suspicious of bladder injury, if the presence of a wound (see below) or history of local trauma has directed one's attention to this region.

(f) **CATHETERIZATION OF THE BLADDER, CYSTOSCOPY, ETC** It seems almost superfluous at the present day, to state that a catheter should not be inserted for diagnostic purposes unless every precaution has been taken to prevent infection. Catheterization is of value in three ways. 1. **IF IT IS IMPOSSIBLE TO ENTER THE BLADDER AND ONLY BLOOD IS OBTAINED, ONE MUST SUSPECT A RUPTURE OF THE MEMBRANOUS URETHRA**, especially in crushing injuries or falls upon the perineum. The presence of ecchymosis over the scrotal and perineal regions confirms the likelihood of the presence of a torn urethra, which may or not be accompanied by a rupture or wound of the bladder.

2 IF A RELATIVELY LARGE AMOUNT⁴ (150-300 cc) OF CLEAR OR ONLY SLIGHTLY BLOOD STAINED URINE is obtained upon inserting the catheter into the bladder one can safely wait for at least 6 to 12 hours watching constantly, however for the local signs of peritonitis, perivesical cellulitis and the changes in leukocyte count, temperature (rectal) and pulse

3 IF ONLY A SMALL AMOUNT OF BLOOD OR VERY BLOODY URINE IS OBTAINED, one can inject 180-200 cc. of sterile water and note the quantity to be aspirated If very little is obtained the test is of considerable value but not infallible as to the presence of a bladder injury

AN INGENIOUS NEW TEST IN THE DIAONOSIS OF BLADDER PERFORATION OR RUPTURE has been suggested by Vaughan and Rudnick⁵ 150 to 200 cc of air are introduced through a catheter and a radiographic film exposed with the patient lying on the left side In negative cases the bladder alone is seen to have been



FIG 304.—To illustrate use of air insufflation method of Vaughan and Rudnick (see text) for detection of rupture of bladder and of urethra at prostatomembranous junction.

A. Before insufflation of air

B. After air was introduced through urethral catheter. Note lighter areas due to escape of air into perivesical tissues (indicated by arrow). The urethral catheter is seen to be bent upon itself. This is due to fact that at operation a complete tear of the urethra was found behind triangular ligament, thus simulating a rupture (extraperitoneal) of the bladder

filled. In extraperitoneal wounds, the air is seen to collect between the fascial planes (Fig 304) while in intraperitoneal cases the air is seen between the coils of intestines and forms a translucent layer just beneath the peritoneum of the anterior abdominal wall and shifts with changes of position. The test is worthy of further trial. We have utilized this principle in the diagnosis of an intraperitoneal rupture of the bladder. The presence of air in the subphrenic spaces (Fig 305) injected during cystoscopy enabled us to make an early diagnosis of intraperitoneal rupture of the bladder

Mark (Jour Amer Med Assn. 1933 100 42) employed excretory urography in the diagnosis of an extraperitoneal rupture of the bladder which was confirmed at operation. We have had occasion to employ this method and can warmly recom-

In a recent case at the Cook County Hospital, 800 cc of slightly turbid urine was obtained. The Vaughan-Rudnick test revealed however the presence of air in the perivesical tissues. At operation, a ruptured urethra was found. The urine had been obtained evidently from the perivesical space. Jour Amer Med. Ass'n 1924 83 9 (July 5)

ment it. The extravasation around the bladder in extraperitoneal rupture is plainly visible on the film.

The examination of the abdominal wall, pelvic bones, perineum and anterior wall of the rectum, should be made routinely for evidence of injury. A thorough inspection of these should be one of the first steps in the examination of a suspected case. Wounds of entrance (or of exit), ecchymoses, fractures or dislocations of the pelvic bones (as seen on radiographs), should be taken into consideration in conjunction with the history of the mode of injury.

Symptoms and Diagnosis in Late Cases In the intraperitoneal form of bladder injury or of perforation, the symptoms are those of a generalized peri-

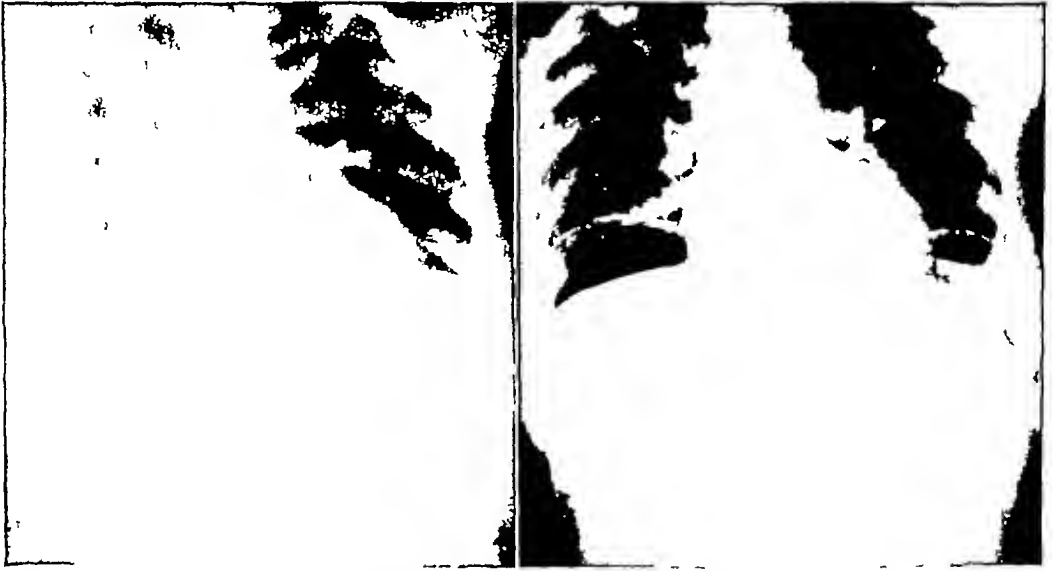


FIG. 305.—Plain film before (on left) and after (on right) introduction of air into bladder during cystoscopy in case of intraperitoneal rupture of bladder. Note collection of air in both subphrenic spaces.

tonitis, viz., diffuse abdominal rigidity, tympanitis, vomiting, obstipation, rapid pulse, etc.

In the extraperitoneal form, the cellulitis of the perivesical tissues gives rise to symptoms of generalized toxemia, plus those of the local infiltration, that is, brawny induration and swelling over the lower abdomen and perineum.

Treatment of Bladder Injuries

This is of but little avail unless the diagnosis has been made comparatively early, i.e., in the first 24 to 48 hours. If the external evidence of injury and the history point to a wound of entrance from either the perineum or rectum, an external urethrotomy affords the best method of drainage. If, however, there is suspicion of the rupture or perforation having involved the bladder from above, no time should be lost in exposing the viscus through a suprapubic incision. If this reveals an extraperitoneal wound or rupture, the bladder should be opened and drainage by tube established. If an intraperitoneal rupture or perforation is suspected, the peritoneum must be opened and this aspect of the bladder exposed. The wound should be closed with two rows of sutures and the bladder drained through an inlying urethral catheter (Fig. 101).

Attention was directed in Chapter II on Anatomy to the fact that, as Wesson

has shown the posterior layer (Fig 48) of the triangular ligament is much less resistant than the anterior layer. For this reason a rupture of the membranous portion of the urethra, which complicates a fracture, at or near the pubic symphysis (see Fig 226), is very apt to be followed by escape of urine into the cellular tissue around the bladder, and not toward the perineum and scrotum.

Under such circumstances an injury of the deep urethra (behind the anterior layer of the triangular ligament) is indistinguishable from an extraperitoneal rupture (Fig 303) of the bladder.

In general it may be said that in the treatment of suspected deep urethral and bladder injuries no time should be lost in waiting for symptoms of urinary extravasation. If there is bleeding from the urethra or the patient passes a bloody urine or the latter is obtained on catheterization or one is unable to introduce a catheter into the deep urethra, do not wait and attempt to catheterize the patient a few hours later especially if radiography has revealed a fracture of the pelvis. Under local anesthesia (Fig 164) the bladder and deep urethra can be rapidly explored. This is preferable to repeated urethral catheterization with its potential dangers of ascending renal infection and is also preferable to exposure of the torn urethra or vesical neck, through a perineal incision.

SPONTANEOUS RUPTURE OF THE BLADDER

This type of rupture of the bladder differs chiefly from those previously described in its etiology. It may take place in the normal bladder or in one whose walls are the seat of pathologic changes. Stone (Arch Surg 1931 23, 129) found 42 cases in both sexes in 21 of which there was no lesion in the bladder. Eleven additional cases have been reported since 1931. Why a spontaneous rupture should take place in a normal bladder is not quite clear. In Barnes and Steele's case (Jour Amer Med Assn 1935 105 1758) the patient, a man 36 years of age, felt a sudden severe pain in the abdomen 18 hours before admission while straining to void. The lower part of the abdomen was found on admission to be rigid and tender and the bladder to contain numerous clots. Cystoscopic examination revealed a ragged tear in the dome of the bladder. A cystogram showed diffusion of the opaque medium into the peritoneal cavity. The diagnosis of intraperitoneal rupture was confirmed at operation. In Saphir and Shapiro's case the only demonstrable change was an extensive replacement of the muscular wall of the bladder by fat.

Spontaneous rupture has been reported following straining to empty the bladder in chronic retention due to urethral stricture or enlarged prostate.

Other pathological conditions reported as having been found include tuberculous ulcer, solitary ulcer, carcinoma and weakness of bladder wall as the result of neurogenic dysfunction.

A spontaneous perforation either extra or intraperitoneal should always be suspected if a mass remains above the pubis following evacuation of the bladder accompanied either by signs of perivesical urinary infiltration or of incipient peritonitis as in a traumatic rupture. The treatment does not differ in any respect from that outlined above for rupture following injury.

Perforation of the bladder by sequestra following osteomyelitis of the pelvic bones and rupture of perivesical foci of suppuration into the bladder are taken up in Chapter 25.

CHAPTER 25

CYSTITIS AND PERICYSTITIS

CYSTITIS

ACUTE CYSTITIS

CHRONIC CYSTITIS

WITH PREDOMINANT INVOLVEMENT OF THE
MUCOSA

WITH PREDOMINANT INVOLVEMENT OF THE
SUBMUCOUS AND MUSCULAR COATS

SYMPTOMS

DIAGNOSIS

CHRONIC TRIGONAL CYSTITIS

SYPHILIS OF BLADDER

BILHARZIOSIS

ECHINOCOCCUS

PERICYSTITIS

BLADDER FISTULAE

CYSTITIS

Cystitis may be due to one or more of the following

1 The ordinary pyogenic bacteria, e g , those described in Chapter 8 as being divided into Gram-positive and Gram-negative In the order of frequency, these are bacillus coli, staphylococci and streptococci, gonococcus and urea decomposing organisms

2 The Tubercle Bacillus This never gives rise to a primary cystitis, the infection of the bladder being secondary to a renal or genital tuberculosis, very rarely to a communication with some perivesical focus

3 Chemical Cystitis This follows the accidental or deliberate (as an abortifacient) injection of strong caustics such as lye, acids, etc , into the bladder The resulting pathological changes are analogous to those due to bacterial causes

4 Thermal or Electrical Causes The reaction to the application of ordinary heat or that of an electrical current is also similar, at least in its early stages, to that due to bacterial action

5 Certain nonbacterial forms of infection, such as *Entamoeba coli*, *Distoma haematobium* (bilharzia) and spirochaeta (syphilis), give rise to changes which can be considered as specific

Modes of Infection

Excluding the last four forms, the bladder is infected in one or more of the following ways

1 By Way of the Urethra (urethrogenous route)

1a BY DIRECT EXTENSION FROM AN INFECTION OF THE POSTERIOR URETHRA

This is uncommon in acute, but not so in chronic gonorrhea, as well as in infections due to the ordinary pyogenic bacteria Extension may occasionally take place from a tuberculous urethritis (primary in the epididymis¹) but usually the urethra is involved secondary to a tuberculous cystitis

1b INTRODUCTION OF UNCLEAN INSTRUMENTS, e g , catheters, sounds, cystoscopes, foreign bodies for the purpose of masturbation, etc However, the normal bladder is relatively immune to infection The normal urethra contains ordinary pyogenic bacteria near the external meatus but their number decreases rapidly as one approaches the bladder In the female, infection of the urethra with extension to the bladder is favored by the proximity of the external meatus to the vagina, as well as by changes following parturition

¹ See Chapter 20

2. **Descending Route** i.e. from the Kidney and Ureter This constitutes the mode of infection in such a large proportion of cases that a primary focus in the bladder is considered to be very uncommon. It is important to bear in mind clinically that the majority of cases of cystitis are secondary to an upper urinary tract infection. The localization of bacteria thus carried to the bladder by the urine is favored by any of the forms of obstruction, of muscular atony or of local irritants (see predisposing causes later)

3. **Hematogenous Route** This is less common than either the urethral or the renal modes of infection especially in cystitis due to the ordinary pyogenic bacteria. In syphilis, amebic cystitis or bilharziosis the causative agent is carried to the bladder by the blood stream (hematogenous)

4. **Lymphogenous** This also is rare. There is a rich network of lymphatics at the base of the bladder which communicates with that of the prostate and seminal vesicles but it is difficult to prove the transmission of infection to the bladder from the two last named structures. The same is true of rectal conditions

5. **By way of fistulae** between the bladder and adjacent structures such as the colon, appendix, rectum, vagina, fallopian tube, ovary, open urachus, etc. The possibility of such a communication being the source of the infection must be constantly borne in mind. We shall refer to this again in Chapter 47 on the interpretation of pyuria

6. **By Reflux** This is described more fully in Chapter 39. It means that as the result of incompetency of the mechanism which normally prevents the contents of the bladder from being forced back into the ureter when the detrusor muscle contracts the infected urine from the bladder regurgitates into the ureter and vice versa. This is important clinically, because if this condition exists efforts to treat a chronic cystitis will be of no avail until the constant reciprocal infection of the kidneys and bladder is overcome

Predisposing Factors in Cystitis²

The following conditions favor localization of bacteria in the bladder

1. Presence of blood clots, calculi, foreign bodies, tumors of the bladder
2. Obstruction at the vesical neck (Fig. 251) trigone or urethra (Chapter 18)
3. Pregnancy, constipation, cold, etc.
4. Residual urine in women either following parturition, operation or as the result of a cystocele or independently
5. Atony of the detrusor of central origin (tabes, etc.) or due to atherosclerotic changes (senile atony) or of congenital origin

ACUTE CYSTITIS

Pathologic and Cystoscopic Changes.

In acute cystitis the intensity of the changes depends to a great extent upon the type of infection. The gonococcus gives rise to marked hemorrhages into the trigonal mucosa, and only on rare occasions does it involve the bladder proper. The *Bacillus coli* varies according to the particular strain of the organism

²The various causes are enumerated in Chapter 39

The clinical pictures, diagnosis and treatment of acute and chronic (nontuberculous) cystitis will be considered separately

to the bladder, as to the end of the penis and perineum. In the female, it is localized at the vesical neck. As a rule, the pain is most intense during the act of urination, less frequently before or after it. It may be continuous⁶ and is then intensified by urination. Pain on pressure over the bladder region is inconstant.

1c PYURIA. In the early stages, the urine is only slightly turbid, later there is marked turbidity even when there is only superficial involvement of the epithelium. Not only the first but also the (Fig 190) second glass shows turbidity. The number of pus cells to the high power field is a fairly accurate index of the degree of infection. It must be remembered that a bacteriuria may exist in which the urine is turbid, but contains very few pus cells. The determination of the type of infection by staining and cultural methods is described in Chapter 8 and will be referred to again under renal infections in Chapter 39.

2 Cases in which Hematuria Predominates. In some patients, other symptoms such as pain and frequency are in the background and the chief complaint is of hematuria. This is especially to be seen when the cystitis has been preceded by some severe systemic infection such as a tonsillitis or influenza or after pyelonephritis due to violent strains of *Bacillus coli*. It also occurs in certain forms of blood dyscrasias, such as thrombopenic purpura,⁷ scurvy, etc. In these the hematuria is due to purpurallike ecchymoses, either scattered or more diffuse, into the mucosa of the bladder or it may arise by diapedesis, in the kidney.⁷ In many cases in which the other clinical picture, viz., frequency, pain, etc., is predominant, microscopic or even gross hematuria is not an uncommon accompaniment.

Fever if present in an acute cystitis is always indicative of a pyelonephritis unless some local focus of suppuration such as a pericystitis, prostatic abscess, epididymitis, etc., are responsible for the rise in temperature.

Diagnosis of Acute Cystitis

The triad of symptoms, pain during urination, frequency and pyuria should be considered in conjunction with the history. In the cases in which hematuria predominates there is often a history of some generalized infection, as stated above. The history may yield information of the (a) passage of catheters or other instruments, (b) of a co-existing or preceding urethritis, or (c) of the presence of a foreign body or calculus in the bladder, (d) the appearance of the symptoms after taking large doses of some drug like urotropin. If the two glass test (Fig 190) is used, both will show turbidity. In some cases, the degree of pyuria is minimal compared to the severity of the symptoms. In others, the degree of hematuria is very marked, and accompanied by the pain and frequency incident to acute cystitis, results in a syndrome which greatly alarms the patient.

Treatment of Acute Cystitis

General Measures. These include (a) rest in bed, (b) hot sitz bath, (c) Priessnitz compresses⁸ over the bladder region, (c) plenty of fluids, especially

⁶ In cases of tenesmus the pain is so severe that in order to relieve it the patient will make an effort to empty the bladder almost continuously (tenesmus).

⁷ See Chapter 47 on Interpretation of Hematuria.

⁸ A Turkish towel is immersed in hot water well wrung out and wrapped around the lower abdomen. A thick blanket or electric pad serve to keep the towel hot.

certain teas like those made of linseed linden flowers camomile etc. (d) the internal administration of alkalies etc., and (e) opiates either by mouth or preferably in the form of suppositories

For (d) we usually employ a mixture containing fifteen grains of potassium citrate four to five minims of tincture of belladonna to one teaspoonful of a saw-palmetto and sandalwood oil mixture now prepared by several pharmaceutical houses. We order such a mixture to be given every three to four hours unless the belladonna causes dryness of the throat

As to (e) we prefer a suppository (rectal) containing one-fourth of a grain of extract of opium combining it with the same dose of extract of belladonna or hyoscyamus unless the patient is already receiving relatively large doses of these by mouth.

Local Measures. In the majority of acute cystitis cases we have found that it is advisable not to attempt to irrigate the bladder or instil any medication until the more severe symptoms have subsided. This is especially true of an acute cystitis complicating a posterior urethritis of gonorrheal origin. After subsidence of the more acute symptoms local treatment is indicated. We prefer to begin with mild antiseptic solutions such as 1 10,000 of either permanganate of potassium or acriflavine at times simply using a four per cent boric acid solution. Not more than one or two ounces should ever be injected at a time in these subacute cases because the musculature is very irritable and the bladder capacity so reduced that any overdistension is quite painful. Later on we prefer to use either a stronger (1 5000) acriflavine or begin with weak nitrate of silver 1 20,000 and gradually increase the strength to 1 5 000. In some cases the colloidal silver solutions (argyrol silver nucleinate albargin) act equally as well

CHRONIC CYSTITIS

Two Forms. Until 1915 when Hunner⁶ made his first report on what he termed elusive ulcer of the bladder there was little difference of opinion as to the pathology and clinical aspects of chronic cystitis. It was the generally accepted view that in chronic cystitis the pathologic changes were as in the acute form of infection limited to the epithelial and to a lesser extent to the submucous layers of the bladder wall. Since the appearance of Hunner's paper there have been a number of others by Keene Kretschmer Fowler Braasch, Paschkis and others on the subject of elusive ulcer and its relation to chronic cystitis.

A critical review of the literature leads one to the conclusion that there is evidently a form of chronic nontuberculous cystitis in which the pathologic changes are predominantly in the deeper layers i.e. the submucous and muscular layers and according to Keene, even involvement of the perivesical tissues. Accompanying these deeper changes are one or more superficial ulcerations which will be described more fully later. On account of these minute ulcers the term elusive ulcer has been applied by Hunner and others.

In the early period of the study of the condition it was believed that the process was a localized one hence Keene suggested that the term circumscribed panmural ulcerative cystitis would be more descriptive of the underlying pathology than Hunner's term of elusive ulcer.

Recently there has been more and more of a tendency to regard the condi-

tion which gives rise to these superficial ulcerations (Hunner's or elusive ulcer) as simply a part of a generalized vesical infection of a chronic type which involves the entire thickness of the bladder wall. The term panmural cystitis has been suggested by some, while Young¹⁰ employs the term submucous or interstitial cystitis, which we believe is the best suggested thus far.

THE CHIEF DIFFERENCE apparently between chronic cystitis as it has been known to pathologists and clinicians, and the more recently studied submucous or interstitial cystitis, so far as we can ascertain, is the comparative freedom of the mucosa in the submucous or interstitial form and the predominance of panmural changes, while in the classical form of chronic cystitis, the mucosa is predominantly involved. Clinically, there is a close resemblance between the two.

In an attempt to clarify somewhat the situation concerning the relation of the cases of elusive ulcer to chronic cystitis, we shall take up the pathology and clinical aspects of the latter under two headings, thus:

- 1 Chronic cystitis with predominant involvement of the mucosa
- 2 Chronic cystitis with predominant involvement of the other coats

1 CHRONIC CYSTITIS WITH PREDOMINANT INVOLVEMENT OF THE MUCOSA¹¹

Etiology

The modes of invasion and the bacteria responsible for this form of chronic cystitis do not differ from those just described under the acute form. The predisposing causes are also practically the same and may be summarized as follows:

- (a) Any form of obstruction at the bladder outlet or prostatic urethra, as taken up in Chapter 18
- (b) Any form of obstruction in the penile or membranous urethra, as taken up in Chapters 13 and 17
- (c) The presence of diverticula, calculi, neoplasms, etc., in the bladder itself
- (d) Any condition which favors residual urine such as cystocele, atony of the detrusor whether of neurologic or peripheral (atherosclerotic) origin and similar conditions
- (e) Communication with other viscera (sigmoid, rectum, vagina, etc.)
- (f) Parasitic infections, especially with bilharzia (see later)

Pathologic and Cystoscopic Changes

The changes in the mucosa vary according to the severity of the infection. Infiltration with mono and polymorphonuclear leukocytes, edema and congestion alone, are found, with similar changes in the submucous layer. In more advanced cases, one may find a number of changes in the mucosa and submucosa which are less commonly encountered in the milder cases. These are:

- (a) **ULCERATIONS**, when calculi are present or independently of these, appear whose floor is covered with granulation tissue. At times, polypoid outgrowths appear over these ulcerated areas which, when edematous may resemble papillomata but are never branched like these (see Chapter 27). The floor of ulcers,

¹⁰ Urology, 1926, 1, 139

¹¹ Synonyms, epithelial lining and also mucous membrane. Although the title does not exclude the accompanying involvement of the other coats to some extent, yet for clinical purposes it seems a convenient term.

instead of granulation tissue may be covered by a fibrinopurulent, firmly adherent exudate or become incrustated with phosphatic deposits especially if the infection is due to one of the urea decomposing organisms (*B. Salmonella*) as Hager and Magath have shown.

(b) **CYSTITIS CYSTICA AND GLANDULARIS** Glands are not found in the normal bladder mucosa. Under the influence of chronic infection the surface epithelium sends down outgrowths which may be solid buds or gland like depressions (Brünn) ending in cyst formation. The first results of such changes in chronic cystitis are the appearance of minute vesicles, usually with clear contents just as one finds in the ureter (Fig. 373) and renal pelvis. The term cystitis cystica has been applied to this chronic inflammatory change.

(c) **CYSTITIS EMPHYSEMATOSA** This is a condition in which innumerable small gas-containing vesicles are seen scattered over the mucous membrane of the bladder. The disease received little attention until 1926 when Hueper reported 11 cases found at necropsy. No further cases were reported until 1930 when Mills reported 12 cases all observed at necropsy. Ravich and Katzen (*Jour. Amer. Med. Ass'n* 1932 98 1256) reported the first case observed ante mortem with recovery. It was impossible to do a cystoscopy because of constant bleeding of apparently vesical origin so immediate cystostomy was performed. The bladder wall was found thick and edematous especially the mucosa and submucosa. The mucosa was covered with numerous clear gas-containing vesicles varying in size from a pin head to a pea the mucosa being hemorrhagic everywhere between the vesicles.

Burrell (*Jour. Urol.* 1936 36 690) collected 27 reported cases of which only six were in males. Wells (*Jour. Urol.* 1938 39 391) has recently reported seven cases observed at necropsy of which five were in males.

Little is known concerning the etiology. There is usually an associated acute or chronic cystitis. In two reported cases gross hematuria was the outstanding symptom. Wells (*loc. cit.*) is of the opinion that in the cases found at necropsy the condition must have developed shortly before death. This is borne out by Sanes and Doroshaw's observation in which a child was cystoscoped seven days before death to determine the cause of a pyuria but no evidence of cystitis emphysematosa found.

The relation to diabetes has been pointed out by several authors but there was no history of this disease in a number of the reported cases. The first reported case in which a diagnosis of cystitis emphysematosa was made on cystoscopic examination is reported by Levin (*Jour. Urol.* 1938 39 45). The patient was a woman 57 years of age who had a diabetes of many years standing. During a search for the source of a hematuria inspection of the bladder revealed numerous cystlike elevations scattered in groups and singly over the entire mucosa. Air bubbles were seen coming off from several of the vesicles. Between these areas subacute inflammatory changes such as intense hyperemia and punctuate hemorrhages occur. Anaerobic cultures of the bladder urine showed the offending organism to be *Clostridium welchii* (*B. welchii*). The bladder condition improved greatly following ingestion of large quantities of buttermilk and treatment of the diabetes.

(d) **GRANULAR OR FOLLICULAR ELEVATIONS** These are often seen in chronic cystitis as small dull red elevations the size of a small lentil. They are seldom

elevated much above the level of the adjacent mucosa. They have a predilection for the trigone but may be seen at times on the posterior or lateral walls close to the trigone. On rare occasions, we have observed these nodules scattered widely over all parts of the bladder. Anatomically they are collections of lymphocytes. They appear after subsidence of the infection, but may be more marked in recurrences.

(e) **GRANULOMAS** In a recent¹² study of this complication of chronic cystitis, the term granuloma is applied to localized areas of hyperplasia of the mucosa and submucosa. They vary from minute granula¹³ patches in the mucosa to papillomatous proliferations. They may give rise to hematuria, persistent infection or be mistaken for neoplasms. In the milder types of cystitis, they are low, small and bear no resemblance to neoplasms. With more virulent infections, they may assume the size and appearance of neoplasms, especially in tuberculosis, where they may be widespread and protrude above the adjacent mucosa. The seat both for neoplasms and tuberculous ulcerations, is most commonly around the ureteral orifices, so that the location is of no assistance in differentiating the two.

At times, the granulomas will flatten out or largely disappear, according to Braasch and Hurley, on full distension of the bladder, but this is not true of neoplasms. One cannot rely on microscopic examination of pieces obtained with the cystoscopic rongeur. Granulomas occurring in incrustated cystitis are often quite luxuriant and easily confused with neoplasms, especially since incrustation of the latter is not uncommon. After the removal of a neoplasm by radium or surgical diathermy or after prolonged use of an inlying catheter or suprapubic tube, these granulomas are very apt to be mistaken for recurrences or primary neoplasms. Along the edges of the sphincter, these granulomas may become fibrous and hang down in polypoid form resembling neoplasms. In the latter, however, one can usually see the fine branching vessels and a clearer structure than in these fibrous granulomas. Fulguration is of no benefit unless the underlying infection is eliminated.

(f) **EDEMA BULLOSUM** This alteration of the mucous membrane in chronic cystitis was first described by Kolischer. It is the result of a marked localized edema of the epithelial and submucous coats and is frequently observed not only in chronic cystitis, but also around the opening of fistulae between the bladder and adjacent viscera, as well as over the surface of neoplasms of the uterus, colon, etc., which are invading the bladder wall. These areas of edema bullosum have a characteristic appearance of closely approximated bullae which protrude but little above the adjacent mucosa. They are most frequently seen in the trigone especially in the trigonal cystitis of women (see later). In cases of impaction of a calculus in the mural portion of the ureter, the resulting edema is so marked that all traces of the orifice are obliterated. In tuberculosis of the kidney this edema bullosum of the corresponding ureteral orifice is often of great assistance in localizing the side involved (Plate XII).

(g) **LEUKOPLAKIA** This is a cornification of the epithelium of the bladder¹⁴ mucosa analogous to similar transformation of the most superficial layers of the

¹² Braasch and Hurley. Granulomas in the urinary tract, *J Urol*, 1927, 18, 595 (Dec.)

¹³ These are not identical with cystitis granularis, referred to previously under (a)

¹⁴ Its occurrence in the ureter and renal pelvis are taken up in Chapters 30 and 39

epidermis. It is usually seen on the floor of the bladder and adjacent areas in cases of infection of long standing also associated with vesical calculi, prostatic hypertrophy and the more latent forms of tuberculosis. One sees sharply demarcated, small irregular grayish white islands of dull lustre. The surface is usually smooth. The mucosa around them is intensely red.

We have outlined the above pathological changes so frequently seen on cystoscopic examination in chronic cystitis because a knowledge of their existence is indispensable to the interpretation of cystoscopic pictures.

IN CHRONIC CYSTITIS OF THE TYPE IN WHICH THERE IS PREDOMINANT INVOLVEMENT OF THE MUCOSA THE LATTER PRESENTS A GRAYISH OR DULL RED APPEARANCE. In some cases there is complete obliteration of the vessel markings still persisting from the preceding acute cystitis while in others these markings can again be seen. The latter is especially the case if there has been much proliferation of fibrous tissue in the submucous coat. The surface of the mucosa is seldom smooth in a chronic cystitis but is apt to be thrown up into folds or ridges which appear like trabeculae at times (Plate II).

The etiology of incrustations in chronic cystitis has been greatly cleared up through the investigations of Hagar and Magath.¹⁵ They have proven the direct relation of a special bacillus termed *Salmonella ammoniae* not only to the incrustations at times seen deposited on the bladder wall in chronic cystitis but also to the ulcerations seen in some of these cases and on the surface of neoplasms.

The urine is highly alkaline and the condition often responds to acidification. The alkaline infections of the bladder that so frequently follow cystotomy in the old and debilitated and which cause marked involvement of the surgical wound require considerable attention and prolong the hospitalization of these patients. Irrigation with 1 per cent acetic or phosphoric acid are of value. ammonium chloride and mandelic acid should be given by mouth. Recently Sulfanilamide has been used successfully in a number of these postoperative alkaline infections.

The more advanced evidences of chronic infection just enumerated are usually accompanied by fibrous changes in the submucosa. This may occur chiefly around the bladder neck and even extend into the prostatic urethra resulting in the type of bladder neck obstruction described in Chapter 18 as contracture of the bladder outlet. It may or not be complicated by prostatic hypertrophy. In some cases the fibrosis is more generalized involving the submucous coat extensively and the muscular coat much less so that the bladder as a whole is in a state of chronic contraction and its capacity greatly reduced (Young).

CHRONIC CYSTITIS WITH PREDOMINANT INVOLVEMENT OF THE SUBMUCOUS AND MUSCULAR COATS

The relation of this condition to elusive ulcer has been discussed earlier in this chapter. There are two views as to whether or not this is a condition which differs radically from the type of cystitis just described as involving the mucosa predominantly. Ringleb a pupil of Nitze who described the lesion in 1907 believes

¹⁵ J. A. M. A. 10:5:85:1352 (October 31) also their recent article in the same Journal 1928, no. 266 (January 28) on the formation of vesical calculi.

that it is a pathologic and clinical entity Ringleb¹⁰ terms it parenchymatous cystitis, which is quite analogous to the terms panmural cystitis as suggested by Hunner, Keene and others Young on the other hand, terms this type of cystitis, submucous or interstitial He (Young), moreover, is of the opinion that the fissures or linear ulcerations are not characteristic of the disease, but are due to previous distension of the bladder, and heal rapidly after a cystoscopy

This difference of opinion as to whether these fissures or superficial ulcerations, which are often found on ribbon like ridges, are primary or secondary, i.e., due to overdistension of a bladder whose coats have undergone fibrosis, is still an unsettled question Both from the standpoint of pathology and clinical recognition (cystoscopy), the essential point is that there is unquestionably a type of chronic cystitis in which there is a dense fibrosis in the submucous and muscular coats, whose cause is unknown Some improve after focal infections have been cleared up, others do not The bladder capacity is decreased as the result of fibrosis, chiefly of the areolar tissue of the submucous layer Even a small degree of distension causes a painful desire to urinate The surface of the mucosa may reveal few changes aside from slight edema or reddening in many cases In a few cases, one sees fissure or linear ulcerations chiefly at the vertex or anterior wall In general, the symptoms are out of all proportion to the cystoscopic findings Hunner, Kretschmer and others have described the superficial ulcerations as varying from a pin point to 5 cm in length and very narrow, e.g., 1 to 2 mm in width Hunner noted the concomitant presence of stricture of the ureter in 60 of his 102 cases In Kretschmer's series of forty-four cases the urine was usually clear In nineteen of the forty-four, the urine was sterile, while in seventeen it revealed the ordinary pyogenic bacteria (*B. coli*, staphylococci and streptococci were found) After a critical review of all of the literature on the subject, one must conclude that this form of cystitis with minimal involvement of the mucosa and predominant fibrosis of the submucosa, muscularis and even perivesical layers, is a definite pathologic and clinical entity

SYMPTOMS AND CLINICAL PICTURES

With the exception of the minimal cystoscopic and urinary findings in the form of cystitis with chiefly submucous and deeper fibrosis, the outstanding features in both forms are practically the same

The clinical pictures under which chronic cystitis presents itself are combinations of every conceivable degree of severity of the triad of symptoms, thus

- (a) Pain related to the act of urination
- (b) Frequency
- (c) Pyuria (less commonly hematuria)

Fever as explained above, is rare in cystitis, with the exception of the thrombophlebitic type When fever of either the continuous or remittent type is present, it, as a rule, indicates a pyelonephritis The exceptions are cases in which some local suppuration, such as pericystitis in the male, pelvic abscess in the female, prostatic abscess or vesiculitis, complicate a cystitis

¹⁰ Lehrbuch der Kystoskopie, 1927

Let us consider the above triad of more or less classical symptoms separately

1 Pain. This is usually complained of as accompanying or preceding urination. The term dysuria is applied to such painful urination, but in our opinion it should be reserved to describe those cases in which there is difficulty of urination as the result of some mechanical or dynamic cause (see Chapter 18). If the pain is a continuous one, i.e., is felt between the acts of urination, it becomes worse during the latter. It is usually referred to the end of the penis or along the course of the urethra at times even to the perineum, scrotum, rectum or inner aspects of the thighs. The pain may persist after the bladder is empty and the desire to urinate recur rapidly, but only a few drops of blood or urine will be expelled with much effort and severe cramp-like pain. The constant recurrence of this cycle has been termed vesical tenesmus or strangury and is most distressing.

2 Frequency. This is often quite marked in interstitial cystitis—frequency is present both day and night in the severe cases and in the presence of a clear urine in the female should make one suspicious of the disease. At times the feeling of wishing to empty the bladder is so urgent that the patient can hardly wait until he is given a urinal, etc. This imperative desire to urinate is termed urgency and may even lead to incontinence in severe cases.

3 Pyuria. Turbidity of the urine is always present in both glasses (Fig 190). Its degree varies according to the severity of the infection in the bladder itself as well as that of the upper urinary tract. If there is marked pyuria¹⁷ with a minimal degree of pain and frequency one should always suspect either a renal source for the pyuria or look for some local condition such as vesical diverticula (Chapter 26). Cystoscopy will soon clear up the question as to whether the bladder changes will account for the pyuria. If this proves negative, ureteral catheterization is indispensable. We are strongly opposed to this last step if there are advanced acute or subacute vesical changes unless inspection of the ureteral orifices reveals¹⁸ the presence of evidences of renal involvement. Hematuria is uncommon in chronic cystitis unless some complication such as a calculus neoplasm, granuloma, etc. is present.

As stated above the degree of pain, frequency and pyuria varies greatly. One may encounter cases with only frequency and pyuria, again others in which persistent pyuria is the only reason why the patient has been referred for urologic study and finally still others in which the pain during urination is the dominating feature. Hunner and Stevens have called attention to frequency as the only symptom in some cases.

DIAGNOSIS

To make a diagnosis of the presence of a cystitis is a much easier task than to ascertain its source. We wish again to draw attention to the fact that the number of cases in which a cystitis is secondary to upper urinary tract pathology is far greater than those in which it is due to some local vesical and paravesical condition. Only a urologic study (see Chapter 10) can determine the source and

¹⁷ The determination of the sources of pyuria and hematuria is taken up more fully in Chapter 47.

¹⁸ Marked edema, prominence and gaping ureteral papillae. (See Plate XII.)

character (whether nontuberculous or tuberculous) of the infection. The triad, pain, frequency and pyuria (less often hematuria) simply tell us that a cystitis is present, but one must never stop there.

This question of the various steps and the interpretation of the findings of a urologic study are so fully taken up in Chapter 39 that it will be unnecessary to repeat them here. Suffice it to say, that a well taken clinical history when combined with the results obtained by such a thorough instrumental and other examination, enables one to determine whether the bladder condition is due to some lesion in the genital or in the urinary tract or both. It yields information as to the nature of the underlying infection and points out the appropriate treatment.

TREATMENT

One can conveniently divide treatment of chronic cystitis into two parts.

1 Palliative measures until a more accurate localizing diagnosis can be made.

2 Measures which aim to eliminate the source of the infection.

Let us consider these separately.

Palliative Measures

These consist of the following:

1 **Remedies to Change the Reaction of the Urine and Relieve Pain.** It has been found that the *Bacillus coli*, which gives rise to about 75 per cent of urinary tract infections, will grow between certain H-ion concentrations as explained more fully in Chapter 39. Certain strains of the colon bacillus develop luxuriantly near the acid, others toward the other (alkaline) end of the H-ion concentration variation. It is easier to attain a maximum alkalinity than the reverse, hence our chief reliance should be the liberal administration of alkalies. For relief of the burning, frequency, etc., we have found that the alkaline belladonna mixture mentioned under the treatment of acute cystitis, suffices. For the severe pain and often tenesmus, opiates in relatively large doses and in the form of rectal suppositories are indispensable. Hot sitz baths afford great relief in many cases. If there is a tendency toward incrustation on the bladder wall or the urine has an ammoniacal odor, indicating activity of urea decomposing bacteria, the use of alkalies is contraindicated until this condition has been overcome. We employ acidifiers in the form of acid sodium phosphate gr \times three times a day, or ammonium chloride gr \times three times a day, or sodium benzoate gr \times three times a day. In addition, we employ urotropin gr \times three times a day.

2 **Local Measures.** The use of the indwelling urethral catheter (Fig. 101) is to be especially recommended for cases of chronic cystitis in both sexes, in which the frequency and painful urination cannot be relieved by the measures mentioned under 1. The bladder can thus be irrigated at regular intervals and the infection soon be brought under control.

In cases which are unable to obtain the necessary hospital care or in which the indwelling catheter does not appear to be indicated, the use of the above mentioned internal remedies should be combined with local treatment in the form of irrigations. For the latter we usually begin with a weak solution of acroflavin 1-8000, nitrate of silver 1-10,000 or merocyl 1-4000 or oxycyanide of mercury

1-6000 One should never inject with a hand syringe more than three to four ounces (90 to 120 cc.) at a time, because the bladder is very irritable and overdistension is painful. The strength of these antiseptic irrigations is gradually increased as the bladder becomes more tolerant. Interstitial cystitis which is not a rare condition and seen mainly in the female presents a difficult problem. This is a chronic condition which often recurs and frequently does not respond well to treatment. Repeated dilatation and over-distention of the bladder in order to increase the bladder capacity is probably the best form of treatment. Occasionally severe hemorrhage may follow overdilatation which frequently must be done under general or spinal anesthesia. Some respond to cystoscopic fulgurations of involved areas. Surgical removal of the lesions does not give satisfactory end results—the patient is often in worse condition than before.

The local treatment of chronic trigonitis in women is taken up separately later.

As soon as the more distressing vesical symptoms have been relieved one should proceed to the next step in the treatment viz urologic study to determine the underlying condition.

Measures which Aim to Eliminate the Cause

If there is an absence of such symptoms as pain and frequency but only pyuria present one need not wait for this step of diagnosis and treatment but proceed at once to ascertain and treat the source of the infection. In some cases of bladder neck obstruction calculus or neoplasm operative measures such as suprapubic drainage (Chapter 50) may be indicated as an alternative measure if the indwelling catheter does not give temporary relief.

In general one may safely proceed to make a complete study of a case of chronic cystitis as soon as the more acute symptoms such as pain frequency urgency etc. have subsided. This examination will determine the following:

- 1 The character¹⁰ of the underlying infection
- 2 The localization i.e. whether primary in the urethra genital tract in both sexes bladder ureter kidney or some perivesical focus
- 3 Whether local treatment i.e. to the bladder alone will suffice or whether it is possible to eliminate a primary source

CHRONIC TRIGONAL CYSTITIS

This deserves special consideration because of its frequency in women. It is usually associated with a urethritis owing to the shortness of the female urethra and its proximity to the vagina. Urethritis trigonitis and other urethral lesions are much more often responsible for bladder symptoms such as pain frequency etc. in the female than in the male (Stevens²⁰). Strictly speaking it is chiefly the result of changes in the trigone (Fig. 41) adjacent internal sphincter and the urethra. The principal changes are, (a) markedly increased vascularization of the trigone (b) edema of the mucosa which usually decreases toward the ureteral orifice. The edematous area may be dull red but more often of a grayish white hue (c) there may be associated granulomas incrustations ulcerations

¹⁰ In Chapter 41 attention is called to the fact that about seventy five per cent of all cases of renal tuberculosis present clinically the symptoms of chronic cystitis.

²⁰ The female bladder 1924 J. A. M. A. 83 1656 Nov. 22

cystitis cystica or edema bullosum, even leukoplakia, according to the severity and chronicity of the infection. In some cases, the trigonal changes are minimal in comparison to the symptoms. One must never be content without a thorough examination of the upper urinary tract for ureteral stricture, and for pyelonephritis, both of nontuberculous and tuberculous origin. One must also search for urethral stricture in women. The treatment should be the same as for chronic cystitis and also the local application of two to five per cent nitrate of silver to the trigone.

SYPHILIS OF BLADDER

Matzenauer is generally given credit for the first cystoscopic diagnosis of vesical syphilis in 1900. According to Ringleb, the description of the lesions discovered by Matzenauer did not include any changes which might be considered as being characteristic for syphilis. These observations stimulated others to search for bladder lesions in secondary and tertiary syphilis. Many cases have been reported since then.

BILHARZIOSIS

This disease is most frequently found in North Africa and has received the appellation of endemic hematuria in Egypt, where a large percentage of the population suffer with it. It is extremely rare in this country. The infection is due to the *Schistosomum haematobium* first discovered by Bilharz. They pass through the skin as embryos, then pass to the portal circulation, the female finally lodging in the veins of the bladder and laying eggs, which pass through the mucosa of the bladder and into its cavity. The involvement in the bladder is that of a chronic cystitis with epithelial proliferation, ulceration and granulation.

The epithelium becomes markedly proliferated with villous outgrowths and structures which simulate bladder tumors. Ulcerations, areas of incrustated cystitis and the formation of bladder stone may constitute the pathologic picture. Secondary infection of the bladder often develops in long standing cases.

Symptoms

Hematuria is an early symptom and is at first painless, only occurring at the end of urination. Later, as a result of aggravation of the process, frequency and dysuria set in. If ulceration and secondary cystitis supervene, symptoms due to these complications develop. Secondary involvement of the pelvis of the kidney is not uncommon. The prostate and seminal vesicles may also be affected.

Diagnosis

This is best made by finding the ova in the urine. They are constantly present.

Treatment

Tartar emetic is a specific for this condition. Intravenous injection of anti-mony tartrate will cure the great majority of cases.

ECHINOCOCCUS

This does not attack the bladder directly, but involves the seminal vesicles and peritoneal cul-de-sac in the true pelvis. The effect on the bladder and the

other structures in the pelvis is due to increase in size and multiplication of the cysts, the symptoms being due to direct pressure on these structures

The symptoms are those of obstruction of the urethra or rectum or both

PERICYSTITIS

This important condition has not received the attention which it deserves. It is an infection of the loose areolar tissue in front of (Fig 40) as well as around

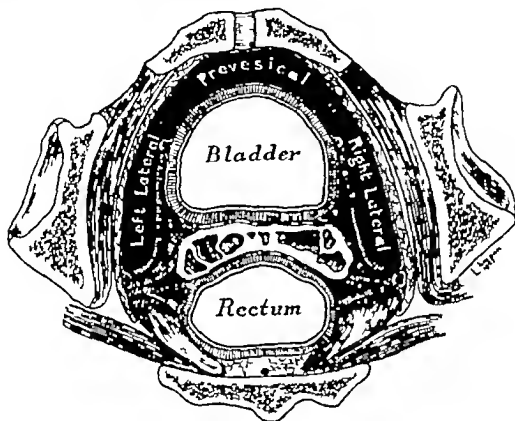


FIG. 306.—Relations of bladder to the perivesical cellular tissue (after Corning)
(See text on Pericystitis.)

the bladder (Fig 306) The infection may either be localized or diffuse In the majority of cases suppuration occurs but when the infection is less virulent a change takes place which may be compared to the woody phlegmon of the neck first described by Reclus In this second more chronic type the areolar tissue is converted into a hard fibrous mass analogous to the perirenal sclerosis described in Chapter 40) Not infrequently a focus of suppuration is still present in the boardlike mass, whose contour resembles that of the bladder We have recently encountered a case in which the induration around the right wall and the dome of the bladder simulated a neoplasm.

Infection reaches the perivesical cellular tissue thus

1 By the hematogenous route as a metastasis from a generalized infection or a focus of suppuration elsewhere in the body

2 By extension from the female genitalia, e.g. in puerperal infection or after gynecologic operations

- 3 As a complication of injuries²¹ of the bladder or posterior urethra
- 4 By extension from infection of the epididymis, prostate, seminal vesicles and urethra (extravasation of urine)
- 5 By extension through the intact vesical wall, e g , as a complication of diverticula of the bladder (see Chapter 26)
- 6 After spontaneous perforation of a diverticulum of the bladder
- 7 As a complication of certain operations, such as suprapubic or perineal prostatectomy, external urethrotomy, herniotomy, etc One of the complications of trans-urethral prostatic resection is a pelvic cellulitis which may result in suppuration extending and spreading peri-vesically

Symptoms and Diagnosis

The symptoms of a generalized toxinemias such as fever, rapid pulse, anorexia, high white blood count, etc , are associated with local evidences of infection The latter include, (a) rigidity and tenderness of the suprapubic region and adjacent areas, (b) on rectal examination (in the more diffuse cases), induration and tenderness over the floor of the bladder If the infection tends toward the woody type, referred to above, one can feel a marked induration whose contour corresponds to that of the bladder With the cystoscope, one may see a bulging of the wall on the side of the infection The urine may be clear If it contains pus, the latter is not the result of the pericystitis, but due to some preexisting vesical condition In the less virulent cases, the board-like rigidity may gradually disappear In the cases of localized or diffuse suppuration, a fatal termination from generalized sepsis is not uncommon, unless the condition is recognized early and proper drainage instituted

Treatment

Drainage from a suprapubic incision alone, suffices if the infection is still confined to the prevesical space If, however, there is a more widespread suppuration extending back to the rectum, only dependent drainage suffices Legueu and Rochet²² and Chute²³ were the first to emphasize the necessity of counter incisions in the perineum Chute's technic is to make a small incision one-half inch from the midline of the perineum and one-half to three quarters of an inch below the pubic symphysis, through the skin and more superficial layers A long curved forceps is introduced from above and at the level of the floor of the bladder, the forceps is guided toward the small perineal incisions and a stiff rubber tube pulled through The tube is left in place until all of the discharge ceases

BLADDER FISTULAE

Fistulous communication of the bladder and adjacent structures may be the result of, (1) some pathological lesion ending in perforation and, (2) of injury during operations, parturition, etc The chief types are

- 1 Enterovesical fistulae

²¹ This includes cases of perforation of the bladder or urethra during the passage of instruments or during lithotripsy

²² Jour d'Urol, 1923, 14, 1

²³ J Urol, 1924, 11 365 (April)

- 2 Vesico-ovarian, tubal, uterine and vaginal fistulae (See Chapter 46)
- 3 Urachovesical fistulae These are taken up in Chapter 26

1 Enterovesical Fistulae *

Pascal¹ collected 195 cases of which 113 were to the rectum 42 to the colon 26 to the ileum 6 to the cecum alone 1 to the cecum and appendix and 6 to the appendix. The traumatic variety may originate from a penetrating or non-penetrating injury or may follow surgical procedures. The nontraumatic variety include inflammatory (abscess, diverticulitis, calculus, stricture and ulcer), i.e. ordinary pyogenic infection, tuberculous, syphilitic, actinomycotic lesions, neoplasms.

The symptoms are passage of gas with the urine (pneumaturo) passage of feces per urethram and of urine per rectum accompanied by frequency and other signs of chronic cystitis. Pneumaturia may also occur as a result of decomposition of sugar in the urine in diabetes. If the communication can be seen on cystoscopic examination further examination is unnecessary. One can also employ the ordinary methods of gastro-intestinal diagnosis (barium by mouth or enema) in order to observe the site of communication. Cystography is also of great service in the same manner. Craig and Lee Brown report (loc cit) a case in which opaque ureteral catheters were introduced along the tract of the fistula and after injecting an opaque solution through the catheter a roentgenogram was obtained of the lumen of the bowel.

Treatment. This is surgical i.e. separation of the two viscera followed by closure of the sites of communication unless the condition is due to tuberculosis. In malignant conditions obliteration of the fistula depends on the ability to remove the primary growth.

* An excellent review of the subject with the report of a case of sigmoidovesical fistula by Craig and Lee Brown (Surz. Gynec. and Obst., 1927 44 753 June) is of much interest.

CHAPTER 26

BLADDER

DIVERTICULA

DEFINITIONS, FORMS AND SIZE

VIEWS AS TO MODE OF ORIGIN

COMPLICATIONS

SYMPTOMS

DIAGNOSIS

TREATMENT

HERNIA OF THE BLADDER

CALCULI

THEORIES OF FORMATION

INCIDENCE, SIZE AND LOCATION

VARIETIES

COMPLICATIONS

SYMPTOMS

DIAGNOSIS

TREATMENT

FOREIGN BODIES

DIVERTICULA

DEFINITIONS, FORMS AND SIZE

A diverticulum is a protrusion or herniation outwards, of a portion or of the entire wall of the bladder, thus forming a cavity which communicates with the lumen of the bladder. The distinction can be made between cellules, or false, and larger, or true, diverticula. The former are simply shallow depressions (Plate VIII) due to protrusion outwards of the epithelial lining alone, between hypertrophied muscle bundles (Fig 307). These latter present on the inner aspect of the bladder as elevations (Fig 307) which unite at every conceivable angle. The cellules are found in much greater number than in the other or true variety, are quite shallow, communicate with the bladder lumen by a relatively wide opening (Fig 307) and are seldom larger than a pea. They may, however, be deeper and the orifice be quite narrow, thus favoring retention of contents and peridiverticulitis (see later).



FIG 307—Necropsy specimen from case of prostatic hypertrophy. Note elongation of prostatic urethra, prominent middle lobe, trabeculation and formation of cellules (shallow diverticula) between the trabeculae. The white marks indicate location of the two ureteral orifices in retroprostatic pouch. Note calculi which have formed in cellules.

The true diverticula vary in size from that of a hazel nut (Fig 308) to a capacity even larger than that of the bladder, having a capacity of 2500 cc. The constituents of the wall vary greatly. In the majority, there is an epithelial lining which is continuous with that of the bladder and around this, fibrous tissue of varying thickness. In nearly all of these "true" diverticula there are well developed muscle fibers. Day and Martin¹ have called attention to the fact that

such a muscular layer is most commonly found in diverticula at the vertex and

¹ Jour Amer Med Assoc, 1925, 84, 268 (Jan 24)

posterior wall of the bladder. Not infrequently, these muscle fibers are so arranged around the neck of the diverticulum as to simulate a sphincter. At times one can observe cystoscopically how the orifice alternately becomes wider and narrower. Blum thinks that this circular arrangement of muscle fibers around the orifice is a true sphincter, but the majority of other observers do not agree with this view.

The opening of a true diverticulum varies greatly in size, but as a rule, is quite small.
This variation is also true of the pedicle or

FIG 308

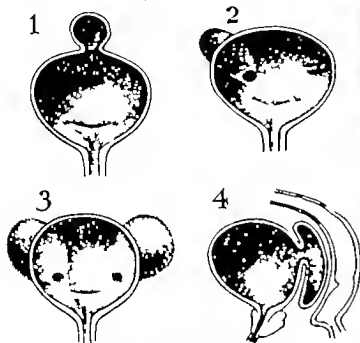


FIG 308—Diagrams of most common locations of vesical diverticula.

- 1 At vertex (very often of urachal origin)
- 2 Just above and mesial to ureteral orifice on one side
- 3 Same, but more or less symmetrically placed.
- 4 Diverticulum developing toward trigone and between bladder and rectum.

FIG 309 Cystograms of diverticula

- A. Multiple diverticula in female aged forty. Note the narrow neck of one on right lateral wall.
- B. Small wide necked diverticulum.



neck which may be very wide or extremely narrow (Fig 309). In the latter type one can readily visualize how difficult it would be for the diverticulum to empty itself.

VIEWS AS TO MODE OF ORIGIN

There is still much difference of opinion as to whether all of the larger (true) diverticula are of congenital origin or arise later in life i.e. are acquired.

Congenital. Some authors maintain that they are all the result of a defective development of the muscle fibers in the embryo and base their opinion on the fact that not only have they been found twice in the fetus, but occur in new born and older children. Hyman recently found that of 600 reported cases of

vesical diverticula, 25 to 30 had been found in children below the age of ten years

Those who support the view that all diverticula are of congenital origin use as an argument, the observation, that with the exception of those at the dome, which are undoubtedly due to persistence of the urachus (see Chaps 1 and 24) the most common location for "true" diverticula is close to the ureteral orifices (Fig 308) where, as English has shown, there is an absence of the longitudinal muscle fibers, so that herniation can readily occur at these points

Acquired Just as there are some, who contend that all diverticula are of congenital origin, so there are others who believe that they are all of acquired origin. The middle ground has the majority of supporters at the present time. According to this generally accepted viewpoint, one must assume that there are



FIG 310—Lateral view of cystogram showing large diverticulum on posterior wall of bladder. The film was exposed with patient lying at angle of 45 degrees to the table.

weak points² in the muscular wall of the bladder of certain individuals, which permit herniation of the epithelial and other coats, when obstruction at the vesical neck or in the urethra, occurs.

Both of the two latter conditions give rise to increased intravesical pressure with its resultant effect on any weak point. That obstruction usually plays an important part, is evident from the fact that diverticula are rarely found when such an obstruction is absent. Even in young adults and children (see Chapter 18) contracture of the vesical neck has been found by Beer and Hyman to occur far more often than formerly suspected.

Relation of Age and Sex There are many urologists who still believe that diverticula only occur after middle age and only in males. This is incorrect.

Hyman and others, have shown that although not common in children and young adults, they must not be left out of consideration in the examination of a patient at this age, presenting symptoms of some bladder disturbance. The majority of diverticula, however, are found above the age of forty. In 133 cases reported by Judd and Scholl, nearly 70 per cent occurred between the ages of 50 and 70 years.

In regard to sex, we have also changed our view. Although the majority of diverticula are found in males, they are not as infrequent in females (Fig 308) as formerly thought. The ratio of their occurrence in females as compared to males is about one to ten.

Location and Number The most frequent (75-80 per cent) locations are in the retrotrigonal area and posterolateral walls near the ureteral orifices (Fig 308). less often subtrigonal on the lateral walls or dome (vertex). The last named type of diverticula is usually due to persistence of the urachus (see Chapter 1).

² It is possible that even well-developed diverticula may remain symptomless until an obstruction results in increased intravesical pressure.

Diverticula may occasionally undermine the trigone to a considerable extent but if so the opening is usually close to a ureteral orifice.

From a study of 222 cases Crenshaw and Compton³ are of the opinion that the majority of diverticula are located at the base and lateral walls and only a few on the posterior wall and dome (vertex).

Only further observation will determine whether this view which differs greatly from that of others will be found to be the correct one. As a rule true



FIG. 311.—Cystogram of large single lateral diverticulum. The exposure was made while patient (a man of seventy-five) was lying partly on his side. Note lighter area at base of bladder due to enlarged prostate.

diverticula occur singly (Fig. 311). If two are found they are more or less symmetrically located in relation to the ureteral orifices. There are a number of cases reported however in which as high as a dozen or more relatively large diverticula were found either during life (Fig. 312) or at autopsy (Fig. 314). There may be a single (unilocular) (Fig. 310) sac or the latter can be multilocular either one portion draining into another or all of the compartments opening into the neck of the sac. One must always bear in mind that the size of the orifice is no criterion of the size of the sac, nor does it yield any information as to whether the

latter is uni- or multilocular. Both of these can be determined with a fair degree of accuracy by other methods (see Diagnosis).

COMPLICATIONS OF DIVERTICULA

1 Infection (Diverticulitis and Peridiverticulitis) Extension of infection from the bladder, takes place very easily and its further development is favored by the anatomical conditions which a uni- or multiloculated diverticular sac, present. They are usually incapable of emptying their contents because of the relatively few muscle fibers in the wall. Added to this are the narrow orifices, in the majority,

FIG 312



FIG 313

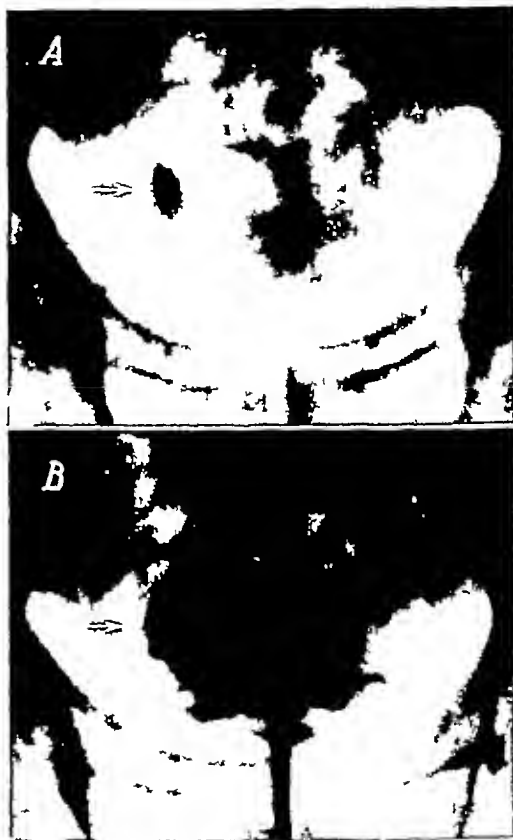


FIG 312—Cystogram showing multiple large diverticula and bilateral reflux. Exposure made in three quarter position i.e. partly turned on side (Courtesy of Dr F M Phifer)

FIG 313—Two radiographs from case in which a calculus was diagnosed by x-ray as lying in a diverticulum and diagnosis confirmed by cystogram. A large calculus lying free in the bladder failed to reveal a shadow in the x-ray but could be seen cystoscopically.

A Shadow of calculus in diverticulum

B Cystogram with multiple shallow diverticula. Note shadow of calculus lying in diverticulum at edge of cystogram as indicated by arrow

through which they communicate with the bladder. In many, the lumen of the pedicle or neck is very small and this in addition to the preceding two factors, favors retention of urine and subsequent infection, not only of their epithelial lining, which is soon desquamated, but of the entire wall, which becomes converted into thick fibrous tissue. The infection does not remain limited to the diverticulum itself, but at a comparatively early period, spreads to the adjacent structures, so that a more or less extensive peridiverticulitis develops. This may only result in very firm adhesions to the rectum, wall of pelvis, etc., but if the contents of the diverticulum have become purulent, the infection may give rise to a perivesical suppuration, either localized or more diffuse. There may be a-

demonstrable perforation of the diverticulum but this is not necessary because the infection can travel at or near the dome of the bladder, a perforation may be followed by a generalized peritonitis.

We have called attention in the chapter on Injuries of the Bladder to the possibility of the perforation of a diverticular sac during unskillful passage of a sound or cystoscope or manipulation of a lithotrite and only wish here to emphasize the necessity of keeping this in mind, in intravesical procedures, especially in elderly individuals of either sex

2 Calculus Formation.

When one recalls, as just outlined the ease with which infection can spread from the bladder to the diverticular sac and the anatomical conditions favoring retention of contents in this cavity. It is not difficult to understand why calculus formation is such a frequent complication. Hager Magath and others have demonstrated the relation between certain types of bacterial infection and calculus formation in the bladder (see section on bladder calculi in this chapter) and the same holds true for a diverticulum which is simply a protrusion outwards of a portion of the bladder. Crenshaw and Crompton¹ found calculi in 12.1 per cent of 222 cases of vesical diverticula. Judd found them in 20 of 133 cases

One encounters the following combinations

- (a) Calculus in the diverticulum alone (Fig 313)
- (b) Calculus in the diverticulum and also in the bladder (Fig 5 of Fig 318)
- (c) A dumbbell calculus, part of which lies in the bladder and the remainder in the diverticulum (6 of Fig 318)
- (d) Calculus in the bladder alone Plate VIII
- (e) Multiple small calculi in cellulæ, (Fig 307)

3 Neoplasms.

These are rare complications of bladder diverticula. Only 40 reported cases were found by Le Comte (Jour Urol 1932 27 667) to which he added a personally observed case. Since 1932 only four other cases have been reported. Hematuria was the outstanding symptom in 77 per cent of the cases. The diagnosis is easy if the tumor can be seen protruding or blood is seen escaping from the orifice of the diverticulum. Papillary or squamous celled carcinoma was most frequently found in the 41 cases reported by Le Comte. Excision is the best method of treatment

4 Hemorrhage

This may be an outstanding feature of the clinical picture (see symptoms and diagnosis below) It may be the result of the infection alone or the presence of a calculus or of a neoplasm in the diverticulum

5 Complications Incident to Relation of Sac to Ureter

Infection of the upper urinary tract can occur as the result of the presence of true diverticula, in one of the following ways

- (a) The ureteral orifice of the corresponding side may lie at the edge of

the diverticular opening or within the sac itself This favors extension of infection to the kidney along the lymphatics of the ureteral wall and its periureteral sheath (see Chapter 40) or along the lumen of the ureter itself if the sac is so located as to obstruct the ureter (Fig 314) The latter may be directly compressed by the diverticulum or may be obliged to take an indirect course (Fig 314) around the wall of the sac before reaching the bladder It is not difficult to visualize how hydroureter and hydronephrosis with subsequent infection can occur under any of the above conditions

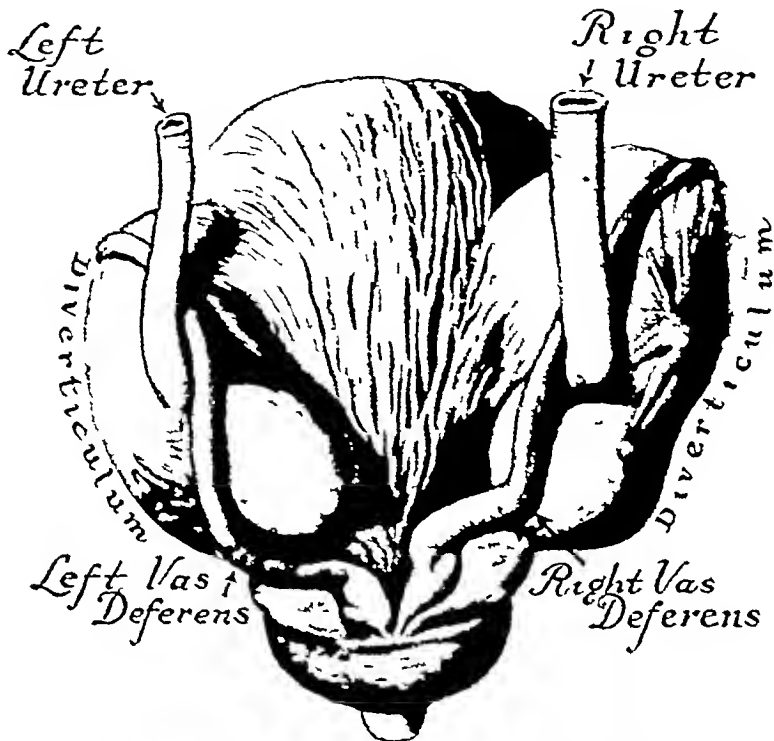


FIG 314—View of bladder from behind showing two large diverticula in close relation to the ureters and vasa deferentia (Tander and Zuckerkindl)

(b) There may be a regurgitation or reflux (Fig 312) of the infected contents of the bladder as well as of the diverticulum into the ureter and renal pelvis The diverticulum is not the chief factor in the reflux but as a complication of an obstruction at the bladder neck or in the urethra it adds another burden to the inability of the bladder musculature to evacuate its contents

6 Obstruction at the Vesical Outlet or in the Urethra

This is found as an accompaniment of the majority of cases of diverticula of any size, after middle age At the vesical neck such an obstruction comprises all of the types referred to in Chapter 18 especially contracture of the vesical orifice Even in children such a contracture of the bladder outlet is being demonstrated as a cause of back pressure favoring the development of diverticula in a constantly increasing number of cases In some of these children a valve formation of congenital origin has been found in the posterior urethra (see Chapter 45)

It cannot be denied that diverticula have been found in both sexes especially in early life without such a demonstrable obstruction These cases occur so seldom that they neither offer a basis for considering all diverticula as of con-

genital origin nor should they permit us to neglect to make a careful search in every case for a possible obstruction

7 Rare Complications.

A case of perforation of a diverticulum, in a man aged 30 following a fall on the abdomen, the bladder being full, was reported by Magoun (Jour Urol 1935, 33 474) A case of spontaneous perforation has been recently reported by Creekmur (Jour Urol 1937 37 363) and the only case on record of a vesico-diverticulovaginal fistula was reported by Swartz (Jour Urol 1937 37 518)

SYMPTOMS

There are no pathognomonic symptoms of vesical diverticula. In the case shown in Fig 311 one was able to palpate a mass the size of an adult fist to the left of and separate from the greatly distended bladder This ability to palpate a diverticulum is a rare occurrence As a rule, diverticula do not present any symptoms which are distinguishable from those of either a cystitis, a pericystitis of non-diverticular origin or from those incident to urethral or bladder neck obstruction. This becomes evident when the symptoms are enumerated which are supposed to be indicative of the presence of one or more vesical diverticula These symptoms as given by various writers are

1 Dysuria, i.e. difficulty in emptying the bladder, up to the point of complete retention or an interruption of the act, so that after voiding a small quantity of urine, there is an interval and this is followed by the passage of a much larger quantity.

2. The persistence of infection, after removal of urethral or vesical neck obstruction Attention has already been called in Chapter 18 to this as suspicious of an overlooked diverticulum in much cases but there are many other cases of persistence of infection so that this finding is also not pathognomonic.

3. Disturbances of micturition, such as frequency, urgency, tenesmus, etc with more or less pyuria. These it will be readily granted are so often observed in ordinary cystitis (see Chapter 25) that they are also not characteristic for diverticula

4 Turbid Urine. Upon catheterization if one obtains at first a clear or even slightly turbid urine and then, especially after exerting suprapubic pressure, suddenly a very turbid urine is evacuated This is of some value, but one must exclude a possible communication of the bladder lumen with some extravescical focus, such as an appendiceal tuboovarian or similar form of localized suppuration.

DIAGNOSIS

We are dependent upon objective methods in the diagnosis of vesical diverticula because there are no symptoms which are pathognomonic. These methods of diagnosis are the following

1 Cystoscopy

One can soon distinguish the cellulæ from the true i.e., larger diverticula by the fact that the former are as a rule shallower, with wide communications and lie between the trabeculations or ridges formed by hypertrophied muscle fibers (see Plate VIII) In the true diverticula the narrow opening with well

demarcated edges and folds of the epithelial lining of the bladder, radiating from this opening, are quite typical findings (see Plate VIII) One can observe how the adjacent epithelial coat of the bladder makes a sharp turn at the orifice of the diverticulum, the opening itself appearing as a dark area At times, the orifice can be seen to change in size, becoming alternately wider and then narrower if there is a sphincter like action of the muscular fibers surrounding the orifice A ureteral catheter can usually be readily introduced through the orifice, for a variable distance into the sac It is of considerable importance to note during a cystoscopic examination, not only the location and number of the diverticular orifices, but also their relation to those of the ureters The latter may be at the edge of the

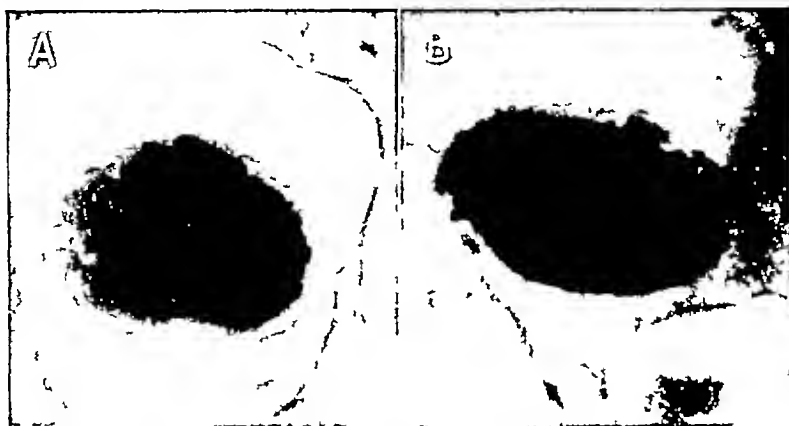


FIG 315—A Anteroposterior view of cystogram with many false diverticula (cellules) in case of bladder neck obstruction

B Lateral view of same cystogram Note one fairly large one on posterior wall

diverticular orifice or within the sac itself One should look during a cystoscopy in such cases, for vesical calculi, for the type of bladder neck obstruction and also whether a calculus protrudes from the orifice of the diverticulum

2 Plain Radiography

Exposures should be made as explained in Chapter 7 in both horizontal and three-quarters (angle of 45 degrees to table) positions On plain films, the location of shadows of calculi lying in one or more diverticula can be seen (Fig 313) by their being more laterally located than in the case of shadows of vesical calculi The exceptions to this frequent finding are (a) calculi lying in a diverticulum on the posterior wall, or (b) in one located beneath the trigone The latter shadows lie near the floor of the pelvis In a case reported by Damski (Jour d'Urol 1934, 37, 509) a large calculus lying in a subtrigonal diverticulum escaped observation during cystoscopy but was found during a suprapubic prostatectomy

3 Cystography and Contrast Cystography (Fig 316)

The technic of these two methods has been taken up in Chapter 7

Plain and contrast cystography yields information as to

- The number, size and location of diverticula (Figs 309, 310 and 311)
- The presence or absence of reflux into the ureters (Fig 312)
- The emptying time of a diverticulum, whether there is retention or not of the opaque medium

Excretory urography has been employed instead of filling the bladder and

diverticula through the urethra, but has no advantages over the latter, except in patients in whom one wishes to avoid use of the catheter. Beer has recommended the use of excretory urography in visualizing the amount of residual urine in cases of bladder neck obstruction. This can also be of value in determining the emptying time of any diverticula.



FIG. 316.—Contrast cystography as used in diagnosis of diverticulum of the bladder. The contrast medium in the bladder has been replaced by air so that the diverticulum stands out prominently against the dark background of the air filled bladder.

4. Passage of Opaque Ureteral Catheter

This is of great importance in determining the relations of the sac to the ureter (see Indications for operation below)

TREATMENT

The following questions present in the majority of cases of vesical diverticula, both in children and adults.

- 1 Is there an accompanying infection of the bladder?
- 2 Does a urethral stricture or some form of vesical neck obstruction complicate the condition?
- 3 Does the diverticulum fail to empty when the bladder contents are expelled?
- 4 What are the relations of the sac to the ureter and other perivesical structures, especially the rectum?
- 5 How much has the upper urinary tract been involved?
- 6 Is there a calculus in the bladder or in the diverticulum or in both?
- 7 Has a papilloma or possibly a carcinoma developed within the sac?

Indications for Operation.

The mere presence of one or more diverticula is not an indication for operation. There are, however, certain definite indications for operation, such as

1 When an acquired urethral stricture has been dilated to its maximum caliber and pyuria persists as the result of one or more vesical diverticula. The same is true for urethral obstruction of congenital origin, e.g., valves

2 When there is an indication at all ages, for removal of a vesical neck obstruction (see Chapter 18), one should always take into consideration the part which one or more retention (true) diverticula⁵ may play, in reinfecting the bladder and upper urinary tract. This is a frequent indication for diverticulectomy (see Chapter 52) especially if one can determine by cystoradioscopy, that there is retention in the diverticulum

3 When there is atony (see Chapter 18) of the bladder as the result of senile changes in its wall, removal of the diverticula has but little to offer toward improving the vesical condition. The same is true of atony of the bladder musculature of cerebrospinal origin

4 If calculi plus infection, are present in the bladder, whether or not there are calculi in the diverticulum, the latter should be removed. This is especially an indication, if there is a dumbbell shaped or smaller calculus in the diverticulum

5 If there is evidence (see diagnosis above) of the ureter being compressed by the diverticulum or its vesical orifice is so located as to favor renal infection, diverticulectomy is also indicated. If none of the above indications are present, it is advisable even after a complete diagnosis has been made, to refrain from operative procedures. It is possible to improve the cystitis and accompanying diverticulitis along the same lines as outlined in Chapter 25. The same is true of localized or more widespread pericystitis complicating a diverticulum. The smaller shallow pouches termed cellules (see Plate VIII) which complicate bladder neck obstructions, senile atony or the so-called "cord" bladder (see Chapter 28), require no special treatment unless they are filled with calculi. If this is the case as shown in Fig. 315, the calculi can be best removed through a suprapubic cystostomy (see Chapter 52) and the cystostomy can be utilized later for the treatment of any obstruction at the vesical neck

The technic and especially the possible complications of diverticulectomy are taken up in Chapter 52 in conjunction with the question of whether a two or three step operation should be performed in cases with accompanying vesical neck obstruction or calculi in the bladder

HERNIA OF THE BLADDER

Definition

A protrusion outward through a hernial opening of a portion of the wall of the bladder

Varieties

(a) **Paraperitoneal** (A of Fig. 317) This is the most common form. Eggenberger⁶ found it in 73 of 110 collected cases and Finsterer⁷ in 30 of 51. The extraperitoneal portion of the bladder is involved. The hernial sac is usually larger

⁵ Day and Martin give as indications for diverticulectomy (a) an hourglass bladder, i.e., a diverticulum as large as the bladder itself, and (b) large single sacs, at or near the dome (vertex) on the lateral walls high up

⁶ Deutsche Zeitschrift für Chirurgie, Vol. 94

⁷ Beiträge zur klinischen Chirurgie, Vol. 81

than the protruding portion of the bladder but the opposite may be true. The bladder herniation lies along the inner (mesial) aspect of the sac and may be hourglass in form or only a narrow diverticulum.

(b) Extraperitoneal (B of Fig 317) In this variety there is an absence of a peritoneal evagination or sac and the hernia is composed of the bladder protrusion alone. Finsterer found 11 of his 51 collected cases to be of this variety.

(c) Intraperitoneal (C of Fig 317) These are very rare. Brunner up to 1896 only found five and since that time only three have been added. It involves the intraperitoneal portion of the bladder there being an absence of the usual hernial sac derived from the peritoneum.

Sex Age and Hernial Ring involved

The proportion of males to females is as 3 to 2 and the majority are found beyond the fiftieth year. The hernia was of the indirect inguinal type in 53 per cent of the femoral in 27 per cent and direct inguinal in 17.

Etiology

Some authors are of the opinion that many of the paraperitoneal variety are the result of traction upon the bladder during isolation of the neck of the hernial sac. This will only explain a relatively small number of the cases. The most plausible view is that beyond middle age both the abdominal and vesical walls become flaccid so that the bladder which normally reaches to the external ring when empty or partly filled can easily be drawn through a wide ring especially if there has been more or less pericystitis as the result of a bladder neck obstruction.



FIG. 317.—Diagrams of various types of bladder herniae.

B Bladder proper.
D Hernial protrusion of bladder.
H Same of peritoneum.

Symptoms and Diagnosis.

The majority of bladder herniae pursue a latent course and are accidental findings during herniotomies. The dysuria, frequency and pain on urination so often complained of are due to a concomitant bladder condition. In some cases however one should think of a bladder hernia if there is a history of (a) variation in size of the hernial protrusion when the bladder is empty or full and (b) if the patient can only urinate in the erect position and then only after pressure over the hernial protrusion. The suspicion of a bladder hernia can be confirmed by cystography which will reveal a diverticulum of the bladder passing through one of the usual hernial openings.

Treatment.

Operative measures are indicated if the hernia is irreducible or as occasionally happens if incarceration occurs. If a hernial sac lies parallel to the bladder evagination the latter can be recognized either by the presence of a subserous lipoma along the mesial aspect of the sac or by the interlacing muscle fibers of the bladder

wall If possible, the bladder protrusion should be separated very carefully and pushed inward before the remainder of the sac is mobilized and ligated high up

Injury of the bladder during herniotomy is a far less common occurrence than formerly If it is impossible to separate the bladder from the hernial sac in the paraperitoneal, i e , in the most frequent variety of bladder hernia, one must be content with a low ligation of the sac and a replacement both of the sac and bladder evagination The problem of reduction is a far more simple one, in the other two varieties of bladder hernia, viz , in the extra and in the intra-peritoneal varieties

VESICAL CALCULI

Primary and Secondary Calculi

The term primary is applied to a calculus which has been formed in that portion of the urinary tract in which it is found All renal and the majority (606 out of 621 according to Crenshaw and Compton) of vesical calculi are primary A small percentage of calculi found in the bladder have, as a nucleus, a small ureteral or renal calculus, around which a so-termed secondary calculus is formed by deposition of layers of crystalline material

Although Hunner maintains that nearly all ureteral calculi are formed, i e are primary, in the ureter, above a stricture area, this opinion has not been as yet adopted Calculi can form primarily in the prostate (Fig 236) or in the urethra (Fig 230), although many of the latter probably represent calculi which have entered the urethra from the kidney or bladder

The pathologic changes, clinical pictures and treatment of calculi in the upper urinary tract differ from those due to calculi in the lower tract They resemble each other, however, as to the theories of their formation and in their physical characteristics, so that we will consider these together, instead of separately under Renal and Ureteral and again under Vesical Calculi

THEORIES OF FORMATION

The problem of how and why calculi form in the urinary tract is gradually approaching solution Investigations by biochemists and clinicians during the past twenty years have shown the importance of certain theories of formation of urinary calculi and the necessity of discarding others handed down to us almost from antiquity We are still far from having solved the entire problem, but certain theories can at least serve as a working basis until they are disproven by future investigations

The following theories are worthy of serious consideration

- 1 Biochemical changes of colloid-crystalloid imbalance
 - 2 The role of bacteria and stasis
 - 3 Influence of diet and disturbances of metabolism
 - 4 Randall's research on initial lesions
 - 5 Less important factors
- Of lesser importance are
- 6 Geographical and climatic influence
 - 7 Relation of age, sex, race and diathesis

We will discuss these theories of formation of urinary calculus in the order named above.

1. Biochemical factors, i.e., colloid-crystalloid imbalance

Schäfer in 1923 (*Die Physikalische Chemie*, p. 360) showed that the urine is a supersaturated solution with respect to the calculus-forming salts (uric acid, oxalates, phosphates). These are kept in solution through the action of colloids, which he termed protective. Why, under certain conditions, there is a disturbance or imbalance of this colloid-crystalloid balance or equilibrium, so that flocculation of colloids and precipitation of crystalloids takes place, is still the subject of investigation.

Snapper (*Bell Jour Urol* 1936, 8, 337) maintains that the primary factor at least in renal calculi is the formation of a nucleus by colloids in the form of minute mucin or fibrinogen particles or a foreign body (less common). This organic nucleus is then incrustated by one of the less soluble urine compounds. Alternate concentric deposits of colloid and crystalloid now take place until the calculus is formed. The prevention of calculus formation according to Snapper lies in the direction of increasing the stability of the colloids.

To sum up, flocculation of colloids is the primary process and this is followed by their secondary incrustation with salts.

2. The Role of Bacteria and Stasis.

The influence of bacteria on the formation of calculus is not definitely understood. First a close relationship exists between certain types of bacteria and calculus formation is shown by numerous recent studies of the question on (a) the role of urea-splitting and (b) that of non-urea-splitting organisms.

The former, principally bacteria of the salmonella and proteus groups, alkalize the urine by splitting urea, thus favoring precipitation of the insoluble earthy phosphates. Many staphylococci and 40 per cent of the strains of *Staphylococcus albus*, according to Brown and Langham, also possesses the ability to split urea.

The part played by non-urea-splitting organisms such as the streptococci and non-urea-splitting staphylococci is of equal importance to that of the urea-splitting bacteria.

The work of Hellstrom, Crossman, Eisenstaedt, Hryntschak and others has demonstrated the presence of non-urea-splitting bacteria in the nucleus of urinary calculi.

The influence of stasis, whether due to a mechanical obstruction or neurogenic dysfunction in the formation of calculus, if infection be present, is a very important one. A normal urinary tract will eliminate infection rapidly, but the moment stasis occurs, bacteria enter either by the hematogenous or ascending routes (see Chapter 39). The slowing up of the urinary current aids the growth of bacteria and formation of calculi. Whether the latter process takes place as the result of the disturbance of the colloid-crystalloid equilibrium by bacteria is not yet proven.

A clinical observation of some importance in the etiology of urinary calculus is the influence of disease and injury unconnected with the urinary tract. A number of cases of calculus formation were reported during the war following gun and fractures of the femur (Joly) as well as after long immobilization for tuberculous of the hip, spine, etc. fractures of the lower extre

Abeshouse (Arch Surg, 1935, 31, 943) report 14 cases of urinary calculus formation in cases of chronic bone diseases and believe that metastatic infection of the urinary tract is responsible in the formation of calculi in such cases

3 Relation of Diet and Metabolism Disturbances

(a) **ROLE OF VITAMIN-A DEFICIENCY** The question of how important a role, lack of Vitamin A in the diet, plays in the etiology of urinary calculus, is still under investigation Osborne and Mendel were the first to call attention to the frequent occurrence of urinary calculi in rats, fed upon food deficient in Vitamin A These observations were confirmed by a number of other laboratory workers and clinicians From the standpoint of the former, the experiments of Grossman (Zeit Urol Chir 1933, 38, 264) and of Higgins (Jour Urol 1933, 29, 157) are especially interesting The chief effect of avitaminosis in rats is, according to Grossman, desquamation of the epithelial lining of the urinary tract which lies as a cornified detritus and is sometimes encrusted with lime salts In addition, all stages of inflammation from a slight hyperemia to extensive necrosis were found as well as calcareous deposits on the mucous membranes or lying free as calculi The majority of the latter were composed of calcium phosphate, never of uric acid, the nuclei being formed by desquamated and cornified epithelial cells

Higgins fed albino rats a diet deficient in Vitamin A for a period of 250 days Eighty-five per cent developed vesical and 42 per cent renal calculi, composed chiefly of calcium phosphate Uric acid and oxalate calculi were never found

The contributions of McCarrison to the clinical side of the question have been the most important He found that calculosis is most common in hot desert plains where little vegetation is found and gradually declines in incidence from wheat to rice-eating countries Avitaminosis results in desquamation of keratinized epithelium which forms a nucleus for uric acid and urate calculi, the most frequently found varieties Infection is favored by Vitamin A deficiency

In spite of much experimental and clinical evidence that a Vitamin A deficiency may be a factor in the formation of calculus, this has not been definitely proved According to a report of the Council on Pharmacy and Chemistry of the American Medical Association (see Jour A M A, 1935, 105, 1983) avitaminosis does not appear to play a significant part clinically in urinary lithiasis

(b) **DISTURBANCES OF METABOLISM** In normal individuals, as stated previously, the urine is a super-saturated solution with respect to the calculus-forming salts such as uric acid, oxalates and phosphates In disturbances of metabolism these salts appear in the urine in such large quantities as to be easily found by chemical and microscopic examination Why such an oxaluria, phosphaturia and uraturia should occur is not quite clear Whether the protective colloids which normally keep these salts in solution have lost their solvent power, or whether as it would seem probable, an abnormally low threshold in certain individuals favors precipitation of these salts, is not quite clear The part played by oxaluria, phosphaturia and uraturia in the etiology of urinary calculi has never been demonstrated There is, however, much clinical evidence to suggest that recurrent lithiasis bears a direct relation to metabolic disturbance which can be corrected by diet (see Chap 42)

The relation of cystinuria to the formation of cystin calculi is clinically demonstrable Normally, cystine, an amino-acid containing sulphur, is broken down into simpler compounds but in cystinuria it is excreted directly Cystin

calculi are formed by the agglutination of cystin crystals but cystinuria as Sullivan, also Brand and his co-workers have shown may exist where crystals do not appear in the urine. The influence of heredity is a well established fact in cystinuria and will be referred to again later. Looney, Berglund and Graves state that there is no satisfactory explanation as to why one cystinuric develops calculi and another does not.

(c) **HYPERPARATHYROIDISM IN ITS RELATION TO URINARY CALCULUS FORMATION**
The work of Albright, Aub Bauer, Bloomberg Balrd, Colby Barney and Mintz has shown that in hyperparathyroidism due to adenoma of the parathyroids, an increase in the serum calcium and a decrease in the serum phosphorus results from a disturbance in the calcium and phosphorus metabolism. The urine of such patients shows an excess of both calcium and phosphorus crystals and as a result there is a tendency to form calcium phosphate calculi and calcium deposits in the kidneys. This question is discussed again in Chapter 42 on Renal Calculi.

4 **Randall's Research on Initial Renal Lesions** In an attempt to clear up the question of the origin and growth of renal calculi Alexander Randall (Surg Gyn. and Obst. 1937 64 201 and Ann Surg 1937, 105 1009) has formulated the hypothesis that renal calculus formation is dependent upon a preexisting renal lesion. Microscopic studies have shown in 17 per cent of 429 pairs of kidneys, secured at necropsy a deposition of calcium in the walls and intertubular spaces of the renal papilla. In 7 of 28 specimens of renal calculus formation the calculus was intimately attached to this calcium deposit.

Randall believes that the etiology of renal calculus is to be sought in further studies of the physiology and pathology of the renal papilla.

5 **Other Less Important Factors.** That heredity plays an important part in the formation of cystin calculi in certain cases of cystinuria has been well demonstrated by Kretschmer (Jour Urol 1933 30 403) and others. Aside from this type of disturbance of metabolism heredity can be considered as a negligible factor in the etiology of urinary calculi.

Calculus diathesis is a relic of the past according to Joly (Jour Urol 1934 32 563) unless by diathesis is understood the tendency for certain individuals to suffer from a defect of intermediate metabolism.

There is very little evidence to show that hard water i.e. containing an excess of calcium salts has any appreciable effect on calculus formation.

The theory that calculus formation may be influenced by climatic conditions is also unproven. The same is true of race. As to age vesical calculi were formerly more frequent in children but the incidence has greatly decreased as the result of a more liberal diet.

INCIDENCE, SIZE AND LOCATION

Relation of Sex and Age In 621 cases there were only 31 females i.e. about 20 males to 1 female. The average age was 55.5 years only four being found in children under 10 years. Preinldlsberger found that in Southeastern Europe where the calculi are endemic, 429 of 587 cases were under 20 years. In Smyrna over 80 per cent were below that age.

Number Size and Weight. In Crenshaw's series there was only one calculus in two-thirds of the cases and multiple calculi in the remaining third. The number may reach as high as several hundred each the size of a grain of

sand The larger ones are often faceted Vesical calculi vary in size from that of a pinhead to that of a child's head In weight, they may attain 2,800 grams, the average being 20 to 50 grams

Location They may be free and move about easily if small The larger ones fill the bladder lumen completely Some are found in the retrotrigonal pouch (2 of Fig 318) some in cellulles (Fig 318), and others in diverticula (5 and 6 of Fig 318) In a few instances, the calculus may be vesicourethral, in others they extend from the ureter into the bladder (3 of Fig 318) One must always bear in

FIG 318

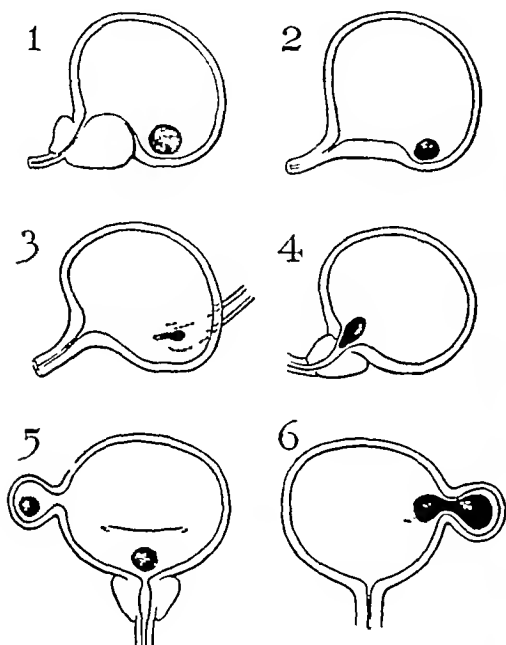


FIG 318—Diagrams of some locations of bladder calculi

1 Behind enlarged prostate (retroprostatic pouch)

2 Behind hypertrophied trigone (retrotrigonal pouch)

3 Ureterovesical calculus

4 Calculus impacted at vesical orifice

5 Calculus in bladder and also one in diverticulum

6 "Dumbbell" calculus in diverticulum and projecting into bladder

FIG 319—The upper illustration is a plain radiograph of a large vesical calculus in an adult The lower one is a plain film exposure of a calculus in a boy of ten years



mind that calculi in other parts of the urinary tract may complicate vesical calculi Crenshaw found renal or ureteral calculi in 20 of 621 cases This emphasizes the necessity of radiography of the entire urinary tract, as a routine procedure

VARIETIES

Vesical calculi are grouped according to their chemical composition There are few which are pure, i e, belong in one group The majority show chemically, a mixture of all of the various commoner crystalline components

1 **Urate Group** These include the pure uric acid and sodium urate calculi They are found as flattened ovoids, are yellow to dark red in color, with smooth, finely granular or even rough surface

2 **Phosphate (Calcium, Magnesium and Ammonium) Group** These are white to greyish in color, with a rough surface. Their form varies greatly. They are very friable and give the deepest radiographic shadow.

3 **Oxalate (Calcium) Group** These are spheroidal, seldom beyond a pigeon's egg in size, are brownish red to dark brown with a very rough mulberry-like surface and are the hardest of all vesical calculi.

4 **Cystin Group** These are yellowish brown granular and are often translucent.

5 **Calcium Carbonate, Xanthin, Cholesterin, Indigo Färbn etc., Group** These are very rare.

COMPLICATIONS

The following potential complications or concomitant conditions must be thought of in every case of bladder calculus.

(a) Impaction in the vesical orifice (4 of Fig 318)

(b) A uni- or bilateral pyelonephritis (see Chapter 39)

(c) Pericystitis

(d) Various degrees of cystitis up to gangrene (see Chapter 25)

(e) Bladder neck obstruction of various types. Crenshaw (loc cit.) found that such an obstruction was due to prostatic adenoma in 277 of 621 cases of bladder calculus.

(f) Urethral stricture (45 in 621 of the Mayo clinic cases)

(g) Diverticula (33 in 621 Mayo clinic cases)

(h) Neoplasm (15 in 621 cases)

These all emphasize the necessity of not limiting our diagnosis (see below) to the presence of a calculus in the lumen of the bladder or in a diverticulum.

SYMPTOMS

Clinically, one finds three groups of cases.

1 **Those which are latent or symptomless** and the calculus is found during examinations for other lesions of the genito-urinary tract. Such cases are comparatively rare.

2. **Masked.** Those in which the symptoms of the calculus are masked by the clinical picture of a cystitis or bladder neck obstruction. One must bear such a possibility in mind in the examination of a case of persistent cystitis etc. especially in younger individuals.

3 **Pathognomic.** Those which are more or less pathognomonic for the presence of a vesical calculus. The symptoms in this more common group, in the order of their diagnostic value are:

(a) **Pain.** This is worse during exertion, hence but little felt on lying down. It is of a sharp cutting character referred to the glans penis, penile urethra and perineum. In addition to being more marked on exertion, it is especially complained of by the patient as being painful during and after the act of urination. Pain is a less outstanding feature of cases where the calculus is encysted in a pouch behind an enlarged prostate or hypertrophied trigone (2 of Fig 318) or lying in cellulæ.

(b) **Disturbances in the Act of Urination.** These vary from increased frequency (most marked during exertion with but little on lying down or rest

ing), to urgency and even tenesmus (see Chapter 10) At times there is dysuria, i.e., difficulty in starting the stream Some writers speak of interruption of the stream as being typical for vesical calculus, but this is so inconstant and can be due to so many other conditions, that one can place but little reliance upon it In children, incontinence is at times the first symptom to direct attention to the urinary tract

(c) Hematuria of either microscopic or macroscopic degree, should at least lead to a thorough examination of the genito-urinary tract in the male and the urinary tract in the female, as shown in Chapter 48 The hematuria which occurs in some of the cases of vesical calculus, has no pathognomonic features and may be equally as well due to vesical neoplasm, enlarged prostate or some renal or ureteral lesion

(d) Prolapse of the rectum, herniae, preputial irritation, etc., are not rare occurrences in children, hence one should always at least examine the urine and think of a possible vesical calculus as the cause of straining at stool or during urination, at this age

If one looks back at the above list of symptoms, it is evident that any or all of them can be equally due to a number of other lesions in the genito-urinary tract, hence it is advisable to combine a well taken clinical history (see Chapter 10) with the purely objective examination which we will now take up, before making a diagnosis of vesical calculus

DIAGNOSIS

Methods of Examination, etc 1 **The Urine** The degree of pyuria or hematuria varies greatly and presents no characteristic features The same is true of finding crystalline deposits in the specimen of urine

2 **Cystoscopy** If the clinical history emphasizes pain on urination as a symptom, a much more complete cystoscopic examination can be made under caudal anesthesia (see Chapter 9) in adults and general anesthesia in children In the latter, radiography should always precede and may take the place of cystoscopy

If the urine is very turbid or bloody, cystoscopy under more or less continuous irrigation is indispensable In the majority of cases a vesical calculus can be readily recognized in a clear field (see Plate VIII) One can secure not only accurate information as to the size, number, location and composition of the calculus, but also as to the degree of accompanying cystitis, vesical neck obstruction, or hypertrophied trigone, openings of diverticula, and last but not least, of a possible complication in the shape of a vesical neoplasm A thorough cystoscopic examination should always include a routine search for all of the above complications A glance at the ureteral orifices (Plates III and XII) will convey to the eye of the experienced cystoscopist a fair notion of whether a possible reflux complicates (see Chapter 39) the vesical calculus

One must bear in mind the following

a A calculus which is encysted, lying behind an enlarged prostate or in a deep retrotrigonal pouch or in a subtrigonal diverticulum can be easily overlooked Very few calculi located in diverticula can be seen on cystoscopic examination, unless the orifice is wide

b One must bear in mind that an area of incrustated cystitis or incrustations

on the surface of a neoplasm especially the latter condition, may simulate a vesical calculus in appearance.

3 Radiography As a rule especially in children (Fig 319) and young adults, a plain radiography (see Chapter 7) should precede a cystoscopy. One can however not place too much reliance on this method of examination. As in the case of ureteral and renal calculi (see Chapters 31 and 42) some forms of calculi give a much fainter shadow than others and occasionally it will happen that as in the case shown in Fig 527 one can demonstrate a fairly large calculus cystoscopically and yet fail to see a shadow roentgenologically. Urates, uric acid and cystin calculi give the faintest while oxalates and phosphates the most intense shadows.

Plain radiography should be followed by ordinary cystography or pneumocystography (Chap 7). These yield information as to the presence of bladder neck obstruction and irregularities in outline due to accompanying neoplasms or to diverticula (Fig 316). At times a shadow seen in the plain film is so far away from that of the usual location of vesical calculi that cystography will help to identify the shadow as corresponding to a calculus lying in a diverticulum (Fig 313). One must always bear in mind that a shadow over or close to the bladder area may be that of a calculus in a congenitally ectopic (pelvic) kidney or in the ureter of an ectopically ending ureter as was found in a case of R. V. Day or finally a calculus in the juxtavesical portion of the normally ending ureter. The differential diagnosis in these three last named cases can only be made with the aid of excretory or retrograde urography.



FIG 520.—Plain film showing shadow of two superimposed calculi

We have found ordinary cystography of value in determining the amount of residual in vesical neck obstruction or neurogenic vesical dysfunction by making an exposure after the patient has voided the contrast medium. This method, as mentioned previously, is invaluable in determining the size, location and emptying time of diverticula accompanying vesical calculi.

4 The Use of the Stone Searcher During the early period of development of the field now termed Urology, the use of a sound with a special tip was the method of choice in the detection of vesical calculi. If the calculus was of fair size and freely movable, one could detect its presence by the peculiar click elicited when it came in contact with the stone. If however the latter was covered with mucus, or was located in a pocket behind the enlarged prostate or in the retrotrigonal pouch, detection was not only difficult but often impossible. With the rapidly increasing use of the cystoscope combined with radiography and cystoscopy, the stone searcher has been discarded.

TREATMENT

Removal of vesical calculi is accomplished in one or two ways

- 1 By litholapaxy (also termed lithotrity)
- 2 By removal through the suprapubic route
- 3 Through a perineal incision as a part of a prostatectomy by this route of approach

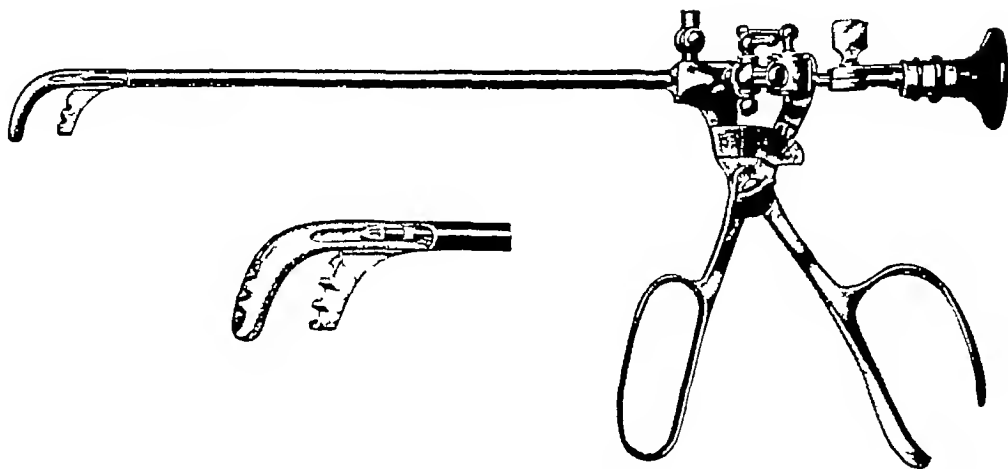


FIG 321 —Ravich lithotripsy scope

1 Litholapaxy

This means the transurethral crushing of a vesical calculus by an instrument, termed a lithotrite. The latter may be of the so-called "blind" type first perfected by Bigelow or of the more recently employed cystoscopic type of lithotrite (Fig 321). In the Bigelow type, the calculus is engaged in the jaws of

the instrument and as soon as crushed, the fragments are evacuated with the aid of a special suction apparatus (Fig 322). In the cystoscopic lithotrite, the entire operation can be performed under the visual control of the operator. Which of these two methods is to be chosen depends upon individual experience. That accidents can happen with the older "blind" method has been known for a long time. Such accidents include injury, even perforation, of the bladder wall by its inclusion within the jaws of the lithotrite. That accidents can also occur during cystoscopic lithotrity is evident in a report by Pulido and de Pena (Jour

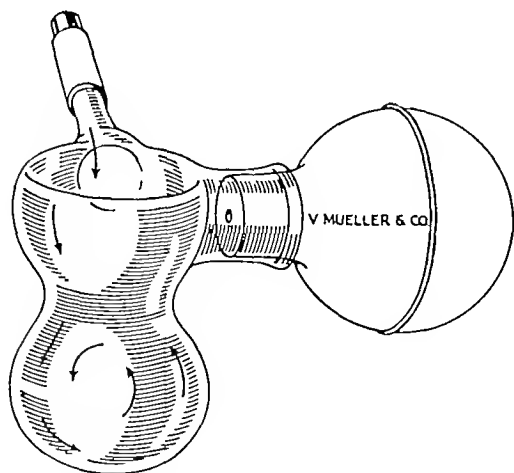


FIG 322 —Ellik evacuator for use in litholapaxy

Urol 1936, 36, 443) of the breaking of a blade during the crushing of a hard calculus.

Litholapaxy should never be performed by anyone not thoroughly familiar with the use of urethral instruments. Although it is the method of choice of a number of urologists, its adoption by others has been very slow.

According to Crenshaw (*loc. cit.*) the mortality following litholapaxy was only 1.3 per cent in 548 cases. In order to be able to perform the operation the caliber of the urethra must be sufficient to permit the passage of a 24 F instrument, the calculus must be relatively small (not over 5 cm in diameter) and the presence of an acute cystitis must be excluded.

The contraindications to litholapaxy according to Crenshaw are

a. A calculus too large to be grasped by the lithotrite

b. A lack of space between the bladder wall and instrument preventing proper manipulation of the lithotrite

c. Absence of enlargement of the prostate bladder tumor or of a diverticulum (Gershom) Thompson has recently advocated litholapaxy following transurethral prostatic resection)

d. In cases of dumbbell calculi (6 of Fig 318) or those with a foreign body as a nucleus or when a calculus adheres to the bladder wall, so that injury of the latter is likely to occur

Technic of Litholapaxy Caudal anesthesia usually suffices but some urologists prefer spinal anesthesia. In cases with much infection it is advisable to prepare the bladder by the use of the inlying urethral (Fig 101) catheter for some weeks.

The patient should be placed in practically the same position as for an ordinary cystoscopy. The calculus is grasped between the jaws of the instrument which are closed against the calculus by a screw attachment. The calculus and all of its component fragments are now crushed. The aspirator is then attached and the contents of the bladder plus fragments of the calculus evacuated by alternately filling and aspirating. Calculi lying behind an enlarged prostate or in the retro-trigonal pouch can be most easily removed by placing the patient in the Trendelenburg position i.e. raising the lower end of the cystoscopic table. Zuckerkandl was of the opinion that at times even phosphatic and urate calculi especially those the size of a walnut resisted all efforts to crush them. In other words it was not the variety of calculus as much as its formation which decided whether it could be crushed or not. One continues to crush the calculus as long as any fragments are visible through the observation lens of the newer cystoscopic lithotrite (Fig 321). The telescope is now removed and the particles aspirated into the evacuator where they drop into a special receptacle. One continues the process of alternately filling the bladder and aspirating the contents until all fragments are seen to have been removed. In most cases it is best to insert an inlying urethral catheter for 24 to 48 hours. Serious damage to the epithelial lining and even perforation of the bladder wall are exceedingly infrequent at the present time when every step of the procedure can be controlled visually. In about 900 litholapaxies, Zuckerkandl only experienced mishaps in 4 cases and these were not due to the jaws of the instrument but occurred at the bottom of a diverticular sac, an accident which could scarcely occur today.

2. Suprapubic or perineal cystostomy

The technic of these operations will be outlined in Chapter 52. The suprapubic method is far safer for the removal of bladder calculi for those who are not accustomed to use a lithotrite i.e., to do a litholapaxy.

Recurrences. One should never attempt to remove a bladder calculus with-

out having made a preliminary study as to whether an obstruction exists, which will favor reformation. This is also true of an infection of the bladder or upper urinary tract, and of central nerve lesions. Crenshaw (*loc cit*) reports 12 recurrences (7.84 per cent) after litholapaxy and 18 (4.55 per cent), followed suprapubic cystostomy in 153 cases. Zuckerkandl had 12 per cent recurrences after litholapaxy, chiefly when an enlarged prostate had been overlooked or not operated even though recognized. His recurrences after suprapubic cystostomy were also about 12 per cent.



FIG 323—Plain film showing foreign body (hairpin) in bladder

FOREIGN BODIES IN THE BLADDER

Modes of entrance

1 Through the urethra (both in the male and female) 2 Through a wound, from all directions 3 Through the wall (from the peritoneum, perivesical space, pelvic bones, etc.)

1 Those entering by way of the urethra. These may be divided into two groups: (a) Intentional introduction during masturbation, or by insane persons. Many foreign bodies have been found in the bladder which have been introduced for erotic purposes, e.g., pins of all varieties (Fig 323), thermometers, etc. In a recent case, we found as the nucleus of a calculus, some rubber tissue which had been inserted a number of years before. (b) Those accidentally introduced. One encounters, not infrequently, cases in which a portion of an ordinary or Pezzar catheter has become detached or a glass catheter has been broken off or a filiform guide attached to a follow-up (Le Fort) sound or catheter, becomes detached and remains in the bladder.

2 Through wounds. A number of cases were reported during the recent World War in which shell fragments were found in the bladder. Other foreign bodies belonging in this group are fragments of clothing, splinters of bone from a fractured pelvis, splint

3 Through the wall. Any foreign body in the perivesical space may ulcerate into the bladder. Sponges overlooked at operation, sequestra following an osteomyelitis of one of the pelvic bones, shell fragments or similar missiles lodged around the bladder all belong in this group.

Incrustation of foreign bodies.

The majority become incrustated with a deposit of phosphatic material so that a calculus is formed which cannot be distinguished from those not so constituted unless a portion of the foreign body protrudes or the history leads one to suspect such a nucleus. Glass and paraffin do not become incrustated. Projectiles such as machine gun or rifle bullets being quite smooth are covered very slowly but any foreign body having a rough or irregular surface such as hairpins, shell fragments, rubber tissue etc., become incrustated very early.

Symptoms and Diagnosis of foreign bodies.

Clinically one encounters two varieties of cases. (a) Those which are symptomless i.e., latent cases. (b) Those which present the symptoms just described as more or less typical of the presence of an ordinary vesical calculus. These are frequency up to the point of urgency and tenesmus (see Chapter 10) hematuria, pyuria, pain (referred to end of penis) on movement and during urination.

The diagnosis depends upon the history, the above symptoms of vesical calculus combined with radiography and cystoscopy. Of these the last mentioned is the most valuable and one can often see the nature of the foreign body unless it has become completely incrustated.

Treatment.

This includes the following methods: 1 Nonsurgical removal (a) Through the operating cystoscope (b) Gasoline for paraffin and 2 Operative removal by suprapubic route.

CHAPTER 27

TUMORS OF THE BLADDER¹

PREDISPOSING FACTORS

CLASSIFICATION OF BLADDER TUMORS

PRIMARY BLADDER TUMORS

DESCRIPTION OF PRIMARY TUMORS

SECONDARY BLADDER TUMORS

RETROVESICAL TUMORS

HOW BLADDER TUMORS SPREAD AND ENDANGER LIFE

SYMPTOMS

DIAGNOSIS

TREATMENT

METHODS

SUMMARY OF METHODS OF TREATMENT

PREDISPOSING FACTORS

Observations over a period of many years by a number of urologists and pathologists have shown that certain conditions, some general, but chiefly local, favor the development of tumors of the bladder. This is especially true of those of the epithelial type (Fig 324) which constitute about 95 per cent of all of the tumors of the bladder. These factors are

1 Long-Continued Irritation, in the Form of Infection. The epithelial lining of the bladder is made

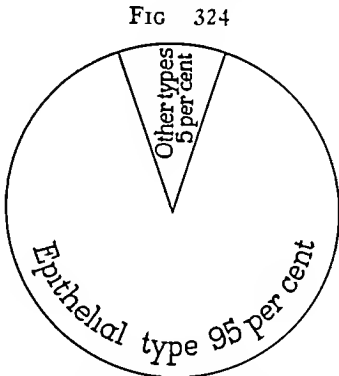


FIG 324

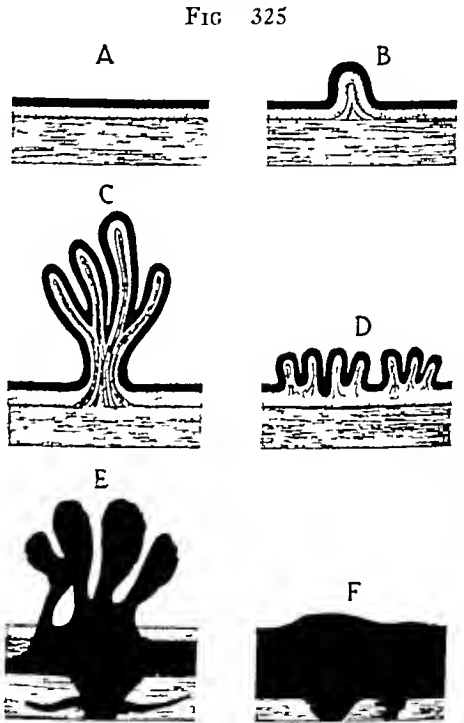


FIG 325

FIG 324—Diagram to illustrate the relative frequency of the various types of tumors of the bladder. Note predominance (95 per cent) of those of the epithelial type.

FIG 325—Diagrammatic representation of mode of origin of various types of bladder cancer. A Normal bladder wall. Epithelial layer shown as solid black line. B Elevation of epithelial layer (mucosa) with its underlying submucous layer and blood vessel. C How a simple (benign) papilloma with long narrow pedicle evolves from B. D Multiple sessile (benign) papillomata arising in similar manner. E A pedunculated or sessile benign papilloma has undergone malignant changes and invaded pedicle as well as submucous and muscular coats of bladder wall. F How an infiltrating (non-papillomatous) cancer invades all of the coats with but little protrusion of tumor into the bladder lumen.

up of layers of cells which represent all stages of transition from the more cylindrical form in the lowermost layers, to a more squamous form at the surface. This combination of cells is extremely sensitive and proliferates easily when there is the slightest irritation. It is possible that the clearing up of some bladder infections by the newer urinary antiseptics, Mandelic Acid and Sulphanilamide, may be indirectly a factor in the reduction of the incidence of bladder tumor. Papillary

¹We are indebted to Dr. Joseph S. Eisenstaedt for suggestions in the revision of this chapter.

formation (Fig 325) takes place very easily but it is not yet settled whether the blood vessels of the submucous coat are the primary factor in this or whether they simply follow the elevations of the epithelial lining

Glands are not found in the normal bladder. Small glands, analogous to those of the prostate, and hence termed aberrant prostatic glands are found at the vesical neck in both sexes.

What were formerly thought to be glands have been shown by Brunn to be gland like depressions of the epithelial lining of the bladder which are often combined with solid buds or sprouts of epithelial cells. At times these may become shut off and have the appearance of glands.

UNDER THE INFLUENCE OF CHRONIC IRRITATION THESE CELL NESTS OF BRUNN MAY BECOME CONVERTED INTO CYSTS and the resultant condition be the same as one sees in the renal pelvis (Chap 39) and in the ureter (Chap 30) namely a cystitis cystica. This latter in turn may become a cystitis glandularis (tubules with a single layer of mucus-producing cylindrical epithelium). From this benign condition to one of the forms of carcinoma is not a very long step. The development of carcinoma in exstrophy as well as in diverticula of the bladder are other examples of the influence of chronic irritation.

2. Relation of calculi to carcinoma. That there is a direct relation between the irritation due to the presence of calculi in the bladder (as well as in the renal pelvis and ureter) and the development of carcinoma is generally accepted. Fuchs² found calculi in 9 of 189 cases of tumors (benign and malignant) of the bladder.

3 Irritation of coal tar products. A contribution³ to this subject by R. Oppenheimer of Frankfurt Germany where so many dye manufacturing plants are located is of great interest. He saw 52 cases during a period of 17 years. Of 37 tumors of the bladder 27 were malignant and 10 benign papillomas. The same individual may have both. The tumors are always of the epithelial type and develop very slowly (average 18.5 years) not only in those directly engaged in the manufacture of the dyes, but also in anyone in the vicinity. The substances (Anilin, Benzidin and Naphthylamin) are absorbed through the skin or lungs and excreted in such form as to cause marked irritation not only of the epithelial lining of the bladder but also of the urethra.

Ferguson and associates⁴ have observed a large series of cases which confirmed the work of Rehn and of Oppenheimer that there is a causal relationship between anilin dyes and tumors of the bladder. Cancer of the bladder has been produced experimentally in dogs by ingestion and subcutaneous injection of coal tar products.

4 Relation of bilharziosis. The irritation resulting from the presence of the ova of this parasite in the bladder wall and the development of carcinoma in such areas has been studied by Goebell.

In general one can conclude that with the exception of the relation of coal tar derivatives and bilharzia to tumors of epithelial type we know little concerning the etiology of bladder tumors.

Zeit. für Urol. Chir. 1925 18 120.

Idem 1927 22 336

See articles by Evans, Wolfe, Gay, Washburn and Ferguson Jour. Uol., 1938, 35 212-250 inclusive.

PLATE IX

A Typical cystoscopic appearance of papilloma (clinically benign) of bladder (Joseph)

B Sessile papilloma (clinically benign) Note delicate clubbed appearance of the individual fronds (Joseph)

C View from a distance, of a papillary carcinoma Note sessile character and the more clubbed and confluent fronds, which is typical of malignant transformation of such a tumor as is shown in A (Joseph)

D Close up view of a papillary carcinoma showing marked clubbing of tips of fronds and their confluence Compare with ability to see individual fronds in a benign tumor as shown in A (Joseph)

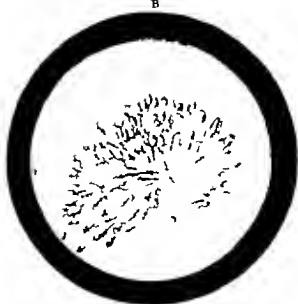
E Typical papillary carcinoma Note almost smooth appearance of surface due to almost complete coalescence of the individual fronds (Joseph)

F Necrotic papillary carcinoma Although necrosis occasionally is seen on the surface of benign, it is a quite common occurrence in malignant neoplasms (Joseph)

A



B



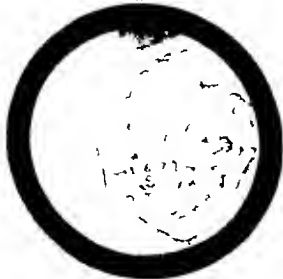
C



D



E



F



second an epithelial covering whose cells are continuous with and resemble in every respect in regard to their arrangement and morphology those of the adjacent epithelial lining of the bladder from whose level the papilloma protrudes

Very few papillomas encountered clinically are of as simple a type as the one just described.

They are usually made up of a principal portion or pedicle which soon branches into a number of villi or fronds. The pedicle may be very narrow or quite wide. It may be relatively long or quite short. If the former we speak of a pedunculated and if the latter of a "sessile" papilloma (Fig 325). The papillomas may occur singly but in a fairly large proportion of cases are found multiple i.e. in a number of places often close together often widely scattered over the bladder (Fig 326)

THE CONNECTIVE TISSUE AND BLOOD VESSELS OF THE STOMA are continuations of the same structures of the submucous layer of the bladder wall. The deeper epithelium of the papilloma is cylindrical and arranged at right angles to the supporting stroma (Fig 329) the more superficial cells are more irregular in shape. There is always a sharp demarcation between the epithelium and the stroma. Necrosis hemorrhage, edema and incrustation not infrequently complicate these simple (often referred to as benign) papillomas (Plate IX)



FIG. 326.—Autopsy specimen of bladder from male aged 20 with multiple small papillomata. Note opening of a diverticulum above left ureteral orifice into which a probe was inserted. Also note the bladder trabeculation.

THEY ARE QUITE MOVABLE (UNLESS SESSILE) on the surrounding epithelial lining of the bladder and can be lifted up so that the pedicle is felt as a soft fold continuous with the adjacent epithelial lining of the bladder

VACCINATION. Some apparently benign papillomata have the property of "vaccination," i.e., of forming secondary tumors of the same structure by implantation. This is a property usually considered as belonging only to malignant tumors. Another peculiar feature is that a recurrence of a clinically and microscopically benign papilloma, may appear as a carcinoma. This is very apt to occur in the scar after cystostomy for bladder tumor

The tips of the villi (or fronds) may end gradually or be clubbed. The latter was formerly thought at least cystoscopically (just like necrosis) to be significant of malignancy but we now know that this can be equally true of benign papillomas. (See table.)

PAPILLOMAS WHICH ARE PRIMARY IN THE RENAL PELVIS OR URETER AND BECOME SECONDARILY IMPLANTED IN THE BLADDER DO NOT DIFFER IN THEIR MACRO- OR MICROSCOPIC APPEARANCE FROM THOSE ARISING PRIMARILY IN THE BLADDER. One

must therefore always bear in mind the possibility of a primary growth in the upper urinary tract in every case of recurrent vesical papilloma

1b Papillary Carcinoma This is characterized by malignant changes at its base. It is the most common form of carcinoma of the bladder. Other types of carcinoma are comparatively rare. The papillary carcinoma is frequently multiple, usually soft and friable, with a necrotic surface (Fig 327) and projects into the lumen of the bladder.

Many of the findings in papillary carcinoma are the same as in the benign⁶ papilloma for example, e g, that the villi may be clubbed, the tumor have a wide



FIG 327—Necropsy specimen of necrotic papillary carcinoma. Note diverticulum (Courtesy of Dr J Kirschbaum)

or narrow pedicle, and also in the matter of incrustation and necrosis. They differ, however, in respect to the fixation of papillary carcinoma, so that in even slightly advanced cases the malignant tumor cannot be moved on the underlying structures. The base will show malignant changes at times even when the fronds will appear benign and on vertical section one can see, on macroscopic examination, the whitish infiltration of the bladder.

INDICATIONS OF MALIGNANCY Microscopically, the fronds may partially or completely resemble those of the benign type. One is struck, however, by a number of features which indicate malignancy.

(a) The polymorphous character of the cells, small and large cells intermingled, small and often very large nuclei arranged irregularly.

⁶ It seems advisable to discard the term benign, because there is unanimity of opinion in regarding every papilloma as a potential carcinoma. In 50 simple papillomata examined microscopically by Zuckerhndl, only 20 were found to be absolutely benign and 12 suspicious, the remainder (36 per cent) already showed evidences of malignancy.

(b) The proliferation of the epithelium into the bladder wall (Fig 325) or into the stroma of the villi

(c) The villi are closely packed together and many of them coalesce so that the tumor becomes a more or less solid mass and sessile i.e., with very little if any pedicle. (Plate IX)

A bladder neoplasm may be papillary and of a low degree of malignancy or it may be papillary and of a high degree of malignancy. It may be flat and ulcerated and of a high degree of malignancy or have the same gross appearance and be of a low degree of malignancy. Broders' grading of papillomata depends on the proportion of normally differentiated cells as compared with the spherical and the irregular cells with prominent nuclei (undifferentiated cells). If about three-fourths of the epithelium on the fronds is differentiated the degree of malignancy is graded on a scale of 1 to 4. If the differentiated and undifferentiated epithelium is about equal it is graded 2. If the undifferentiated epithelium forms about three-fourths of the growth it is graded 3 and if there is no tendency to cell differentiation it is graded 4. We shall see later how this is related to the tendency to recurrence after treatment.

INITIALLY MALIGNANT It is of interest in this connection to note that some of the German pathologists hold that certain papillomata are malignant from the beginning. Kaufmann supported this view stating that papillary carcinoma can arise from a papilloma when the epithelial covering of the latter proliferates in an atypical manner and penetrates the deeper tissues. In some cases however Kaufmann believed that a papillary carcinoma arises primarily from the epithelial lining of the bladder and that benign papilloma and papillary carcinoma may coexist both in the bladder and in the urethra.

Seats of Predilection Sex Age and Size These are for both of the above types of epithelial neoplasms the lower portions of the bladder viz. the trigone and the vicinity of the ureteral orifices (Fig 326).

Both varieties occur more commonly after the age of 50 and oftener in men than women.

1c. Other Less Common Types of Carcinoma These are the tumors which infiltrate the bladder wall without the formation of papillae. The group includes

(a) **SQUAMOUS-CELLED EPITHELIOMA** This may be found either without or with a tendency to cornification of its superficial layers. It tends to infiltrate (Fig 325) the wall and projects but little above the surface of the epithelial lining of the bladder. In this respect it differs greatly from the papilloma and papillary carcinoma. It may convert the wall into a mass a half inch in thickness infiltrate a wide area and yet only show a single ulceration.

(b) **ADENOCARCINOMA** This is a relatively rare type of carcinoma of the bladder. It may occur as a flat ulceration with extensive infiltration of the bladder wall or project as a pedunculated mass into the lumen. As stated at the beginning of this chapter glandular acini are not found in the normal bladder. It is believed that both adenomas and adenocarcinomas either arise from epithelial cell nests (Brünn) or from aberrant prostatic glands at the vesical neck.

2a. Sarcoma. These are comparatively rare only about 130 cases having been reported. A relatively large proportion were found in children and young adults. In one form (the more common) there is a widespread and diffuse infiltration of all of the coats of the bladder. The tumor in this variety projects but little

infiltrating tumors of the bladder, of which necropsy records are available at the Johns Hopkins Hospital shows a percentage of 56.1 with demonstrable metastasis. Leadbetter and Colston (Jour Urol 1937, 38, 267) reported a case of brain metastasis in carcinoma of the bladder. This localization was only found twice in a series of 625 necropsies of patients dying of bladder tumor.

In general, the regional lymph nodes (Fig. 44), liver and lungs are the most frequent seat of metastases.

The most frequent cause of death, leaving aside those due to metastases, is from the results of the blocking of the ureters, less often from the uncontrollable bleeding. The former may cause death either from uremia due to hydronephrotic atrophy of the kidneys, or from pyelonephritis. The latter is often favored by the infection, incident to perforation of adjacent viscera, such as the rectum or sigmoid. Death from uremia or urosepsis may take place even before there is involvement of the regional lymph nodes.

SYMPTOMS OF BLADDER TUMORS

Clinically, cases present themselves with one of the following as the outstanding features:

- 1 Hematuria
- 2 Pain
- 3 Disturbances in the act of urination and pyuria

These may, of course, be combined in any individual case, but in the majority of instances, the chief complaint is one of these three. Let us take them up separately.

1 Hematuria This is the first and often, for a long period, the only symptom. Young states that it was the mode of onset in 404 (75 per cent) of 541 cases of bladder tumors collected by Clado, Geraghty and Verhoogen. Barringer found that hematuria was the first complaint in 130 of 138 of his cases.

Mackenzie found hematuria as the chief complaint in 75 per cent of 288 cases. This most common symptom may be very profuse during its initial appearance or very slight. The blood usually appears fresher and not so intimately mixed with the urine, as in bleeding from kidney tumors. The hematuria may persist until the bladder becomes distended with clots or one of these may block the internal meatus and give rise to retention of urine. In some cases, the hematuria disappears spontaneously and may never recur, or only after a variable interval, the urine becoming clear and remaining so until the next attack of bleeding. It is just this last mentioned type of case which lulls the general practitioner, who so often is first consulted, into a false sense of security and causes postponement of an examination as to the source of the hematuria. Even in children, as Deming has shown, the first symptoms are hematuria and frequency of urination. The degree of bleeding is no criterion of the size or character of the tumor, in both adults and children.

2 Pain This and disturbances of urination are the distinctive features in about 25 per cent of the cases, while in the remaining 75 per cent, hematuria is the initial symptom. In infiltrating bladder carcinoma, pain may be the only early symptom and blood, even on microscopic examination, may be absent.

The pain varies greatly. It may be independent of the act of urination or is

only complained of, as being associated with it. The spontaneous type of pain is often referred to the suprapubic region and perineum. It less frequently radiates along the sciatic nerves than is the case with carcinoma of the prostate (see Chap. 18) but when it is present it means involvement of the sacral nerves by metastatic deposits in the pelvic bones (Fig. 171).

The pain associated with the act of urination is usually referred to the end of the penis or to the bladder itself. If there is much ulceration of the tumor and infiltration of the wall so as to diminish the bladder capacity, it may be almost constant and experienced in the interval between the acts of urination, as well as during the latter.

3. Disturbances of the Act of Urination. These like the two preceding symptoms do not differ in any way from those due to a number of other bladder conditions (see Chap. 10). The urinary symptoms in this group vary from slight dysuria and burning or pain on urination to almost complete retention and more or less constant pain. The more severe symptoms occur in infiltrating tumors involving the bladder neck and in the papillary type situated in the vicinity of the bladder neck. The desire to urinate may become so urgent and the pain accompanying and following the passage of a few drops of bloody urine attain such a degree of severity as to lead to tenesmus, i.e., a constant desire to urinate, preceded accompanied by and followed by pain then temporary relief, until the desire to urinate recurs and the remainder of the cycle reappears.

These symptoms are usually not directly due to the tumor itself but to the accompanying cystitis except in the infiltrating type where the symptoms are due to the tumor itself. A persistent pyuria or the above combination of symptoms referable to the bladder as well as every case of symptomless hematuria, should make one suspicious of a bladder tumor. Blocking of the ureters with or without infection of the stagnant column of urine greatly complicates the later stages of the disease. The symptoms of renal insufficiency and of upper urinary tract infection do not differ from those discussed in Chapter 18.

DIAGNOSIS

Granted that one or more of the three most common symptoms (hematuria, pain and disturbances of micturition) have focused the attention of the physician upon the bladder it is the task of the urologist to make a topical diagnosis. This is undertaken in the following four ways:

1. A general examination for evidences of back pressure on the kidneys, metastases, etc.

2. An examination of the abdomen, rectum, external genitalia and inguinal region (for lymph nodes) to ascertain (a) whether the bladder tumor is secondary (see above) or (b) if primary in the bladder or prostate the degree of infiltration in the case of the former of the floor of the bladder.

3. **Urethroscopy and Cystoscopy.** This should never be done until the

Excretory urography is very useful in determining the degree of obstruction of the upper urinary tract.

It is always advisable if possible, to have radiographic films made of the bones of the pelvis and of the spine for metastases.

other two steps in the examination have been carried out as a more or less routine procedure. Before we take up the cystoscopic diagnosis in detail, it would seem desirable to remind those who have occasion to examine a case of bladder tumor which is bleeding or complicated by cystitis and especially by ulcerations, that the procedure can be far more thoroughly carried out, if (a) caudal anesthesia is employed and (b) if a cystoscope is used which permits of either continuous or interrupted irrigation. For cases of bladder tumor which are not bleeding we use a No. 18F examining cystoscope. If there is much bleeding or the bladder urine is very turbid, we prefer a slightly larger sized cystoscope, viz., a 21F, which will permit water to circulate freely even when the examining telescope (Fig. 116) is inserted into the sheath. We have found that by suddenly checking the escape of the water used for distending the bladder, a clear field will be obtained for a sufficiently long interval to inspect every portion of the bladder in the order referred to in Chapter 6 (see also Fig. 123).

The cystoscopic diagnosis of the presence of a simple papilloma presents but little difficulty. Its differentiation from a papillary carcinoma is one of the most perplexing problems at times and even experienced observers like Geraghty and Joseph have stated that in many instances the diagnosis can only be made by the response which the tumor makes to treatment.

DIFFERENTIATION OF EPITHELIAL TYPES OF TUMORS

	Simple (benign) Papilloma	Papillary Carcinoma	Infiltrating Types of Carcinoma
Pedicle See Plate IX	Seldom visible unless tumor very small. Usually long and narrow. The longer the pedicle is, the more apt is tumor to be benign. The tumor may have a short, wide pedicle, i.e., is sessile. The pedicle when seen, is sharply demarcated.	Pedicle rarely to be seen. No sharp demarcation of pedicle from adjacent epithelial lining of bladder. Latter usually edematous and raised at base of tumor.	Very little if any protrusion of tumor above surrounding epithelial layer, i.e., no pedicle, also marked edema at edges of infiltrated area.
Villi (fronds or papillae) See Plate IX	Usually long and thin with many branches in each of which a tiny vessel. Villi may, however, be clubbed at their tips and short with few branches. Villi are white to flesh colored. Favorite location near ureteral orifices. Tumors may be single or multiple, if latter suspicious of malignancy.	Looks like cauliflower. Entire mass sessile, with villi more apt to be clubbed, also less demarcation between adjacent villi, i.e., they coalesce. Edges of tumors slope off gradually into surrounding tissue, which is often edematous. If tumor recurs after fulgurations or resists treatment very significant of malignancy.	Surface nodular or mammillated or cerebriform, i.e., epithelial lining thrown into folds (irregular), also see evidences of cystitis. Rectal examination important to determine infiltration. Bladder distends poorly, i.e., is contracted.
Necrosis, Incrustation and Ulceration See Plate IX	Necrosis is rare, same true of incrustation. Ulceration never seen.	Marked tendency to necrosis and incrustation. May simulate calculus if incrustated, i.e., covered with calcareous deposit.	Incrustation and ulceration very common. Edges of ulcer are rolled up, raised and floor of ulcer covered with greyish deposit or is incrustated.

DIFFERENTIAL DIAGNOSIS OF GRADE 4 INFILTRATING TUMORS

These may be present without any projection into the cavity of the bladder. The overlying mucous membrane may be intact, so that early diagnosis is often

difficult or impossible. Bleeding in this type of tumor is often a late sign, but pain may be a relatively early symptom. Obstructive symptoms may be evident when an infiltrating tumor involves the vesical neck or when a papillary new growth is located in its vicinity. Rectal palpation may be of great value in the diagnosis of this type of tumor, often additional information may be gained if the cystoscope is left in place.

Although we do not claim that the preceding differential table is infallible still we feel that it may be of some assistance to those whose experience in cystoscopy is not as large as the urologists just mentioned.

The above table is offered as a working guide because only repeated examination of individual cases will at times enable a diagnosis to be made of malignant changes in a benign papilloma or of a primary papillary or infiltrating carcinoma. When one reads such reports as those of Bumpus that 35 per cent of apparently benign papillomata recurred after fulguration or radium it is apparent that cystoscopic diagnosis alone is not always the final step. The pedicle may be malignant and the remainder of the tumor benign or the opposite be the case. For this reason even a biopsy i.e. removal of a portion of the tumor by endovesical methods (see Chap. 52) is being abandoned by many urologists. Unless the entire tumor be subjected to microscopic examination it is evident that one can place but little reliance upon the examination of a portion. At times even serial sections are indispensable. As stated in the table malignancy should be suspected if a papilloma recurs or if there is no response to endovesical fulguration or radium. It cannot be denied, however, that at times even recurrent tumors will disappear after fulguration or radium but if so the patient should be examined at intervals for at least 5 years before the suspicion of malignancy is abandoned. To sum up the clinical behavior of a tumor is at present a most valuable guide as to its being benign or malignant.

CYSTOSCOPY IN OTHER FORMS OF BLADDER TUMORS presents fewer difficulties. A fibromyoma is seen as a localized protrusion with a smooth epithelial covering and without edema of the adjacent tissue. A myxoma may resemble a cyst arising as stated above from aberrant prostatic tubules or from the cell nests of Brünin both of which are more common near the vesical orifice. There are no special features about a sarcoma, except its more widespread involvement of the bladder wall than is the case in an infiltrating carcinoma.

Before leaving the question of cystoscopic diagnosis let us call attention to the necessity of constantly keeping in mind the possibility of the bladder tumor being secondary to a primary neoplasm of the ureter or renal pelvis. This is less difficult if one can see a papilloma protruding from the ureteral orifice or note a bloody efflux from one side. Here ureteropyelography will greatly aid in clearing up the question.

Tumors (either primary or secondary) of the bladder must be differentiated from (a) areas of edema bullosum (Plate II) due to inflammatory changes. These may resemble a sessile papilloma. Some cases of chronic cystitis can be differentiated from tumor only with difficulty. Marked bullous edema may be present about a papilloma. This usually indicates an infiltrating tumor. However the edema may be purely inflammatory and when the patient is again cystoscoped it may have entirely disappeared. In two cases this changed a previously poor prognosis to one considerably more favorable. Inflammation is often associated

with bladder tumors. When a papilloma shows evidence of redness or edema on the surface or base, it is best to wait until inflammatory changes subside before fulguration or surgical diathermy is done. Marked local reaction may occur later if (a) infection is present, (b) from areas of incrustated cystitis, (c) from a syphiloma and (d) from pseudogranulation tissue lying over imbedded ova in cases of bilharzia. In connection with syphilis of the bladder (see Chapter 25) it must not be forgotten that syphilis and carcinoma may coexist.

A primary carcinoma of the urachus may invade the bladder at its vertex and simulate a primary tumor of the bladder.

ENDOMETRIOSIS OF THE BLADDER

This condition is rare. In the cases reported, the endometrial tissue was located on the floor of the bladder near the trigone. Pain and hematuria are particularly noticeable during the menstrual period. This is the chief point in differential diagnosis.

FIG 328



FIG 329



FIG 328—Cystogram of filling defect in bladder tumor

FIG 329—Example of benign papilloma of the bladder. B U I Path 3938. Young's Practice of Urology. W B Saunders Co.

4 Cystography This is only of value in cases of more or less extensive infiltration of the wall, where it will reveal an irregularity and filling defect as shown in Figs 150 and 328.

TREATMENT

The best statistics indicate a five-year survival of only 25 to 30 per cent of patients who have been treated for cancer of the bladder. There is general agreement that small papillomas (papillary epithelioma) should be treated by (a) fulguration alone (Fig 678), (b) fulguration followed by implantation of radon seeds (Fig 675), or (c) by transurethral use of the cutting current as employed by G J Thompson.

Some large papillary tumors can be resected transurethrally with the resectoscopic loop. This offers a satisfactory method in large non infiltrating tumors with a narrow pedicle which are difficult to treat with the fulgurating electrode.

METHODS

At the present time the following methods are being used for carcinoma of the bladder each method having its advocates. It is too early to attempt an evaluation of the merits of particular methods but it may be stated that there is more and more of a tendency to use diathermy by the suprapubic route unless the tumor is so situated as to be accessible to resection.

1 **Röntgen Therapy** This method is being applied by Bothe, Pfahler and a few others. In a recent article (*Jour Urol* 1936 36 651) Bothe reports that seven of twenty two malignant tumors of the bladder had undergone complete regression. He advocates Röntgen therapy as a preparatory treatment to a more radical procedure.

2 **Radium Therapy** Barringer (*Jour Urol* 1936 36 684) is of the opinion that bladder tumors can be better controlled by radium implants than by any other method. His own trend is definitely away from the suprapubic (Fig. 677) toward the cystoscopic (transurethral) implant as shown in Figs. 675 and 676. Further progress in difficult infiltrating tumors is probably along lines which combine interstitial with external irradiation. Barringer believes that but few bladder cancers can be controlled by external irradiation alone.

3 **Operative Removal** Beer, Hunt, Hyman and others advocate resection (Figs. 670-673) with the aid of the cutting current in carcinoma limited to the vault or sides of the bladder whereas if the tumor is on the trigone near one ureteral orifice it is not amenable to resection. Of 27 partial resections collected by the Committee on Carcinoma Registry (*Jour Urol* 1936 35 481) only 5 cases were entirely without evidence of disease by symptom or cystoscopic examination at the end of five years. One hundred and five patients were treated by cystotomy and simple excision of the tumor. Twenty five (23.8 per cent) were without symptomatic cystoscopic evidence of disease at the end of five years.

4 **Transvesical Diathermy** By this method heat is generated in the tumor itself causing its cells to be destroyed without damage to adjacent normal tissue. It is our method of choice the immediate risks being slight in comparison with the number of five year cures. The technic employed at the Michael Reese Hospital is described in Chapter 52 and illustrated in Fig. 674.

A 1 cm. disc and a current of 1500-2000 milliamperes is employed by the majority of those who use transvesical diathermy. It is advisable after applying the electrode to wait for ischemia and the bubbling of gases from the surface of the tumor. The larger the diameter of the electrode the longer the time required for coagulation which is equal in depth to the diameter of the disc electrode. Kirwin (*Surg. Gynec. and Obst.* 1938 66 999) employs a loop or a ball electrode instead of one of the disc (Fig. 674) type. Randall (*Idem* p. 927) cuts away the tumor with a cautery loop electrode including a 1 cm. zone of normal tissue down to the muscular layer of the bladder and then applies the diathermy electrode.

In the report of the Committee on Carcinoma Registry (*loc. cit.*) the transvesical diathermy method is cited as having been used in 121 cases with no cystoscopic evidence of disease in 18 or 14.8 per cent of the patients.

IN THE FIRST STAGE OF TABES (the irritative stage), the patient may complain of loss of sphincter control so that coughing or jostling often causes the loss of a small amount of urine. This is due to a hypertonic bladder with a weakened sphincter. The expulsive mechanism (the detrusor) is markedly increased while the bladder closure is weakened.

IN THE SECOND OR LATE STAGES OF TABES (the paralytic stage) a complete reversal of symptomatology occurs. The patient has difficulty in emptying and has either a large amount of residual urine or has an overflow of retention. This is due to a paralysis of the detrusor and hypertonicity of the sphincter, i.e., the expulsive force is weakened while the bladder closure is increased.

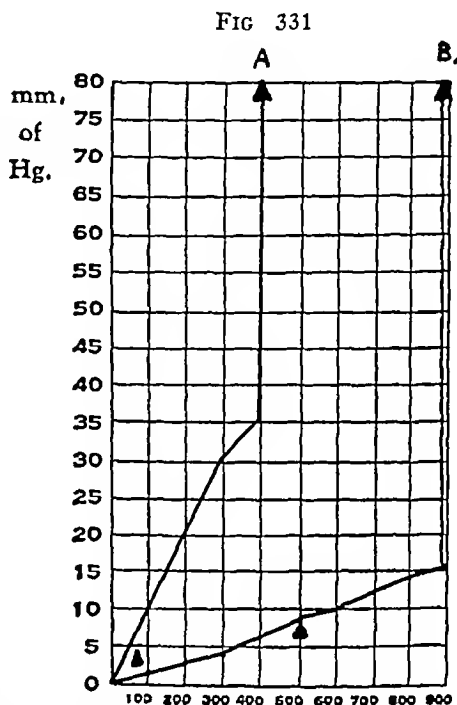
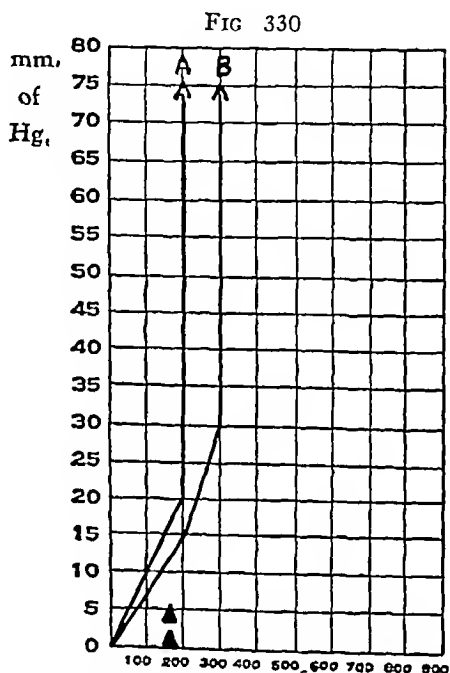


FIG 330—Cystometrograms from case of spinal cord injury at intervals of two years

FIG 331—Cerebrospinal lues complicated by prostatic hypertrophy. Cystometrogram A (March 22, 1935) Neurogenic bladder of hypertonic type. Cystometrogram B (July 17, 1935) Neurogenic bladder of hypotonic type. Showing the change from an irritative condition of the cord to a paralytic state in four months.

By cystometric studies one can observe the gradual change of the hypertonic bladder into the hypotonic type in cases of *tabes dorsalis* (Fig 331).

Irritative lesions of the spinal cord such as tumors, cysts or bone impingement produce bladder phenomena due to increased pressure on the cord. The variety of lesions is great but the effect upon the bladder mechanism is always the same, causing either a hypotonic or hypertonic state.

Cerebral tumors, hemorrhages, angiospasm or injuries will frequently disturb the bladder mechanism either causing complete retention or very slight symptoms only to be detected by careful cystometric study (Figs 332 and 333).

The completely retented bladder in these cases invariably becomes infected with gradual involvement of the entire urinary system. Severe pyuria, chills and fever ensue because of incomplete emptying and increase of intracystic pressure. These cases occasionally develop secondary stones because of stagnation of urine. Ultimately, death from urosepsis supervenes.

INCONTINENCE FOLLOWING PROSTATECTOMY

Miscellaneous Lesions. If one carefully analyzes the behavior of the bladder following prostatectomy, a great many cases are to be found with transitory partial or complete incontinence. This form of incontinence is very often not the result of an injury to the sphincters but of an altered physiology of the bladder mechanism. As the prostate increases in size the musculature of the bladder wall hypertrophies. When the obstructing factor is removed by operation the hypertrophied bladder wall persists with resulting powerful contractions.

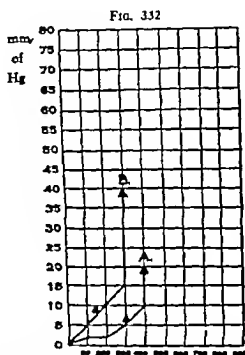


FIG. 332—Fracture dislocation of twelfth dorsal vertebra with cord involvement. Expectant treatment. A, taken May 18, 1935 and B taken May 25, 1935. Note great improvement in one week. While actual urination was not reestablished at the end of the week the improvement shown by the cystometer greatly influenced us to treat expectantly. Complete recovery.

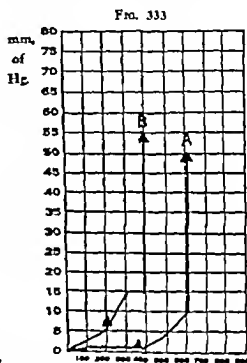


FIG. 333—Extradural sarcoma of spine. A, Before operation. Neurogenic bladder of hypotonic type. B, Five days after operation. Note return to normal pressure curve and desire to urinate.

The response to the urge to void is much stronger so that frequency and intense urgency are established thus simulating incontinence. Such an incontinence will gradually disappear with the administration of sedatives. Very helpful is the wearing of a clamp in training the bladder to retain larger amounts of urine. There is, however, a group of patients who remain permanently incontinent and must undergo some form of operation for its relief. This group of patients cannot ascribe their disability to faulty surgical technique alone. One sees many cases showing no sign of incontinence after a very difficult prostatectomy and yet incontinence will occasionally develop in a case where an easy one was performed. The cause of incontinence in this group of cases is due to chronic infection of the prostate and periprostatic tissues with consequent loss of elasticity. This results in a relaxation of the prostatic urethra. Surgery is the only hope for cure in these cases (Fig. 334).

RETENTION OF URINE CAUSED BY DRUGS such as ephedrine, narcotics or hypnotics is transitory and will disappear after the cessation of use of the drug.

These cases require intermittent catheterization but occasionally an indwelling catheter for several days will be required

IN MEGALOCOLON one finds evidence of hypotonicity of the bladder Presacral sympathectomy improves the function of the colon and the bladder, which is an evidence of a neurogenic origin in hypotonicity of the bladder due to these causes

DIABETES A neurogenic bladder is also found in diabetes due to cellular biochemical changes in the spinal cord These cases rarely improve

IN POLIOMYELITIS, urinary complications are usually very rare However, in the epidemic of 1934 there were very many cases with urinary symptoms ranging from a slight transient dysuria to complete bladder paralysis During the acute phase of the disease, coincident with the distressing pain and contractions in the

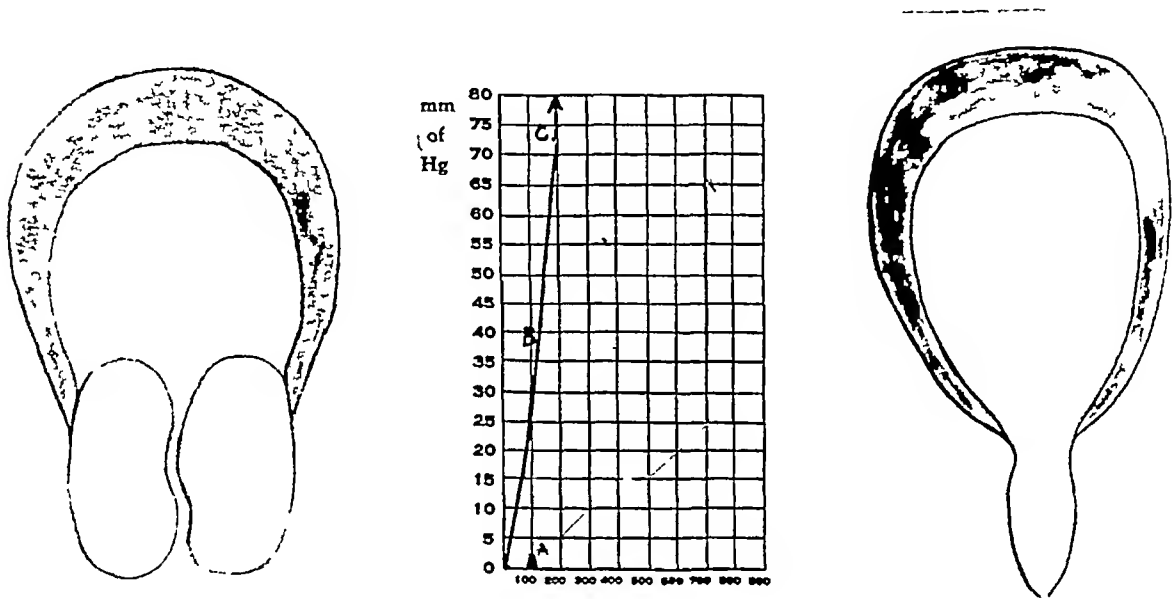


FIG 334 —Diagrams of the cause of incontinence immediately after bladder closure which disappears in time in cases of prostatectomy Left Bladder wall before prostatectomy Right Bladder wall after prostatectomy Middle chart illustrates the hypertonicity of the bladder wall

skeletal muscles, there occurred severe attacks of vesical irritability, bladder spasms and hypogastric pain In younger patients there was an incidence of 20 per cent of urinary disturbances while in adults it was 65 per cent

IN SPINA BIFIDA one finds incontinence due to a hypertonic bladder in addition to a relaxation of the external sphincter

Neurogenic bladder of the hypotonic type has been observed following abdominoperineal resection for carcinoma of the rectum

THE CAUSE OF POSTOPERATIVE RETENTION FOLLOWING MAJOR, ESPECIALLY LOW ABDOMINAL, operations of all types is not understood

DIAGNOSIS

There are Two Varieties of Neurogenic Bladder—the hypertonic and the hypotonic types

THE HYPERTONIC BLADDER IS SMALL because of the increased muscle tonus and relaxed sphincter, causing true incontinence

THE HYPOTONIC BLADDER IS LARGE because of the relaxed musculature and spastic sphincter the overflow of retention simulating incontinence (Figs. 335 and 336)

By Catheter

This method is valuable only in the progressive and late stages. Information can be obtained in the case of a hypotonic bladder by noting the greatly diminished force of the urinary stream flowing out from an 18 F or 20 F catheter. A hyper

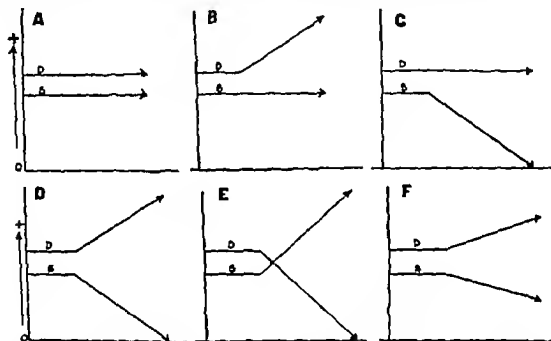


FIG. 335 A.—Normal. d. detrusor and s. sphincter. Both these muscles are represented as stationary with a positive tonus. Balanced evacuation. Deviation upwards will indicate hypertonus while downwards will mean hypotonus.

B Hypertonic detrusor and normal sphincter causing great frequency which can simulate incontinence.

C Normal detrusor and relaxed sphincter as seen after perineal operations, causing partial or complete incontinence.

D Hypertonic detrusor and relaxed sphincter as seen in a neurogenic bladder of hypertonic type resulting in incontinence.

E. Hypotonic detrusor and spastic sphincter as seen in a neurogenic bladder of hypotonic type, resulting in retention with overflow incontinence.

F Hypertrophy of detrusor and relaxed sphincter as seen after suprapubic prostatectomy causing partial incontinence

tonic bladder can be suspected when only a few cc. of urine escape with great force. The finding of a small bladder capacity by injecting sterile water is also significant providing that other causes giving rise to a small bladder capacity are eliminated. In early cases, this method yields no information.

Radiography

The size and contour of the bladder as outlined by an intravenous urogram can be very characteristic especially in the progressive and late cases of a hypotonic bladder. The bladder is very large much larger than in obstructive retention and because of the lack of detrusor tonus will appear bulging in the lower portion of both lateral walls. Such lateral bulging of the bladder can also be demonstrated by injecting one of the opaque mediums and observing the re-

sultant cystograms This procedure is always contraindicated in presence of much infection

Cystoscopic Diagnosis

The most important sign to look for in the hypertonic bladder is the relaxed sphincter, and in the hypotonic bladder, the very fine trabeculation of the bladder wall. Diagnosis by cystoscopy is quite satisfactory in the advanced stages, but it is of no avail in the early and progressive stages because the vesical neck is not noticeably relaxed and the fine trabeculation is not yet evident. A neurogenic

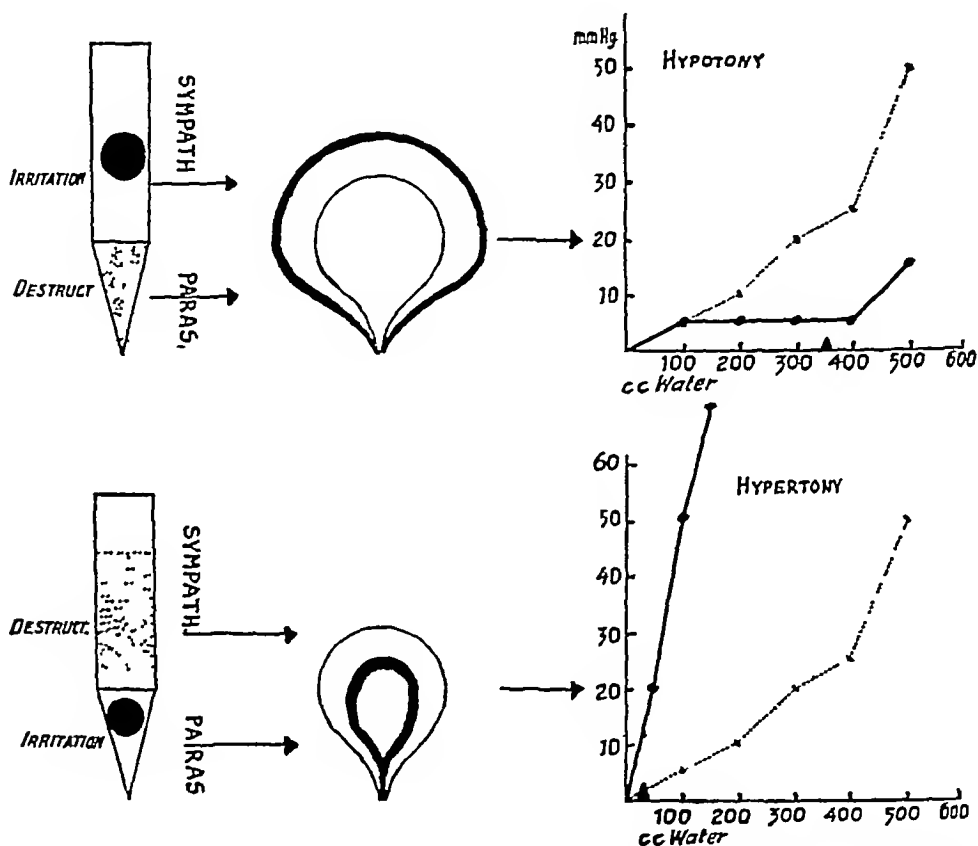


FIG 336—Diagrams to illustrate the different effects of spinal cord lesions on the size of the bladder and on the cystometrogram. The hypertonic bladder is small because of the increased muscle tonus and relaxed sphincter. The hypotonic bladder is large, because of the relaxed musculature and spastic sphincter.

disturbance of the bladder is usually to be suspected because of the absence of an obstructive lesion. Greater difficulty in diagnosis is encountered in cases of neurogenic bladder complicated by obstruction. The enlarging prostate causes the bladder wall musculature to hypertrophy, obliterating the fine trabeculations to be seen in the hypotonic bladder. In the hypertonic type, the enlarged prostate fills in and tightens up the widened vesical neck, thus eliminating the cystoscopic sign of a relaxed sphincter.

The cystoscopic method of diagnosing a neurogenic bladder is possible only in the well-advanced stages and fails to be of value in the early and progressive stages of the disease.

Diagnosis with the aid of Cystometry

The interpretation of the data obtained by cystometry appears to be the most accurate way we possess at present in the detection of dysfunction of the bladder. This method enables one to determine the function of a component of the bladder mechanism whose physiologic status becomes markedly altered early in disease, namely the bladder wall musculature or detrusor. The tonus of the detrusor may be stimulated or depressed. If stimulation of the tonus occurs, it will produce a small bladder with small capacity whereas if depression of the tonus occurs a large bladder due to a relaxed detrusor will be found (Fig. 337).

Cystometer. To determine the change in the tonus of the detrusor the cystometer is employed (Fig. 339). Several forms of cystometers are available

FIG. 337

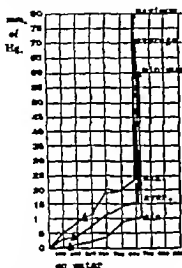


FIG. 338

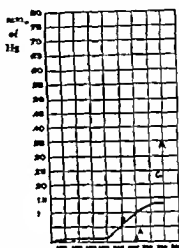


FIG. 337.—Normal cystometrogram. The normal pressure curve (expressed in mm. Hg.) rises slowly with each 100 cc. of filling, becomes more vertical after 500 cc. have been introduced. The normal first desire to void is between 150 cc. and 250 cc. The maximal voluntary pressure is between 40-60 mm. Hg. (see text).

FIG. 338.—Cystometrogram of a hypotonic bladder. Note the low pressure curve, the shift of the first desire to urinate to the right and the low voluntary pressure.

They are all constructed with one objective to measure the intracystic pressure at various fillings. There is available a revolving drum (Rose) water manometer (Munro) mechanical pressure gauge (Lowsley) and the microcystometer (Simmons). We believe that the Muschat cystometer is simple in construction, easy to use and devoid of mechanical errors.

A cystometric study begins with the passage of an 18 F. silk woven catheter to empty the bladder. The catheter is then connected with the cystometer and the bladder gradually filled with water, noting the change in pressures with every 100 cc. of filling, thus obtaining a pressure curve. A very important factor in this study is the determination of the point of the first desire to void. The patient should be instructed to indicate the slightest initial urge to urinate. After the bladder is filled to capacity the patient is instructed to force the contents out against the manometer, thus recording another important factor—the maximal voluntary bladder pressure. Three factors are thus obtained: (a) First desire to void, (b) the pressure curve, (c) maximal voluntary pressure.

The normal pressure curve rises slowly with each 100 cc. of filling, becoming more vertical after 500 cc. have been introduced. The normal first desire to void

is between 150 and 250 cc The maximal voluntary pressure is between 40 and 60 cc (Fig 337)

In the Hypotonic Bladder the Curve is Flat Instead of a gradual increase, the bladder pressure remains low and continues to remain low even after 500 cc of filling The initial low pressure may remain unchanged in extreme cases even after 1000 cc of water have entered the bladder The first desire to void is greatly delayed, appearing at 350, 500 or 800 cc of filling The maximal voluntary pressure is low, always under 40 mm

The hypotonic bladder, therefore, is the one with a low pressure curve, shift of the first desire to urinate to the right and low maximal voluntary pressure (Fig 338)

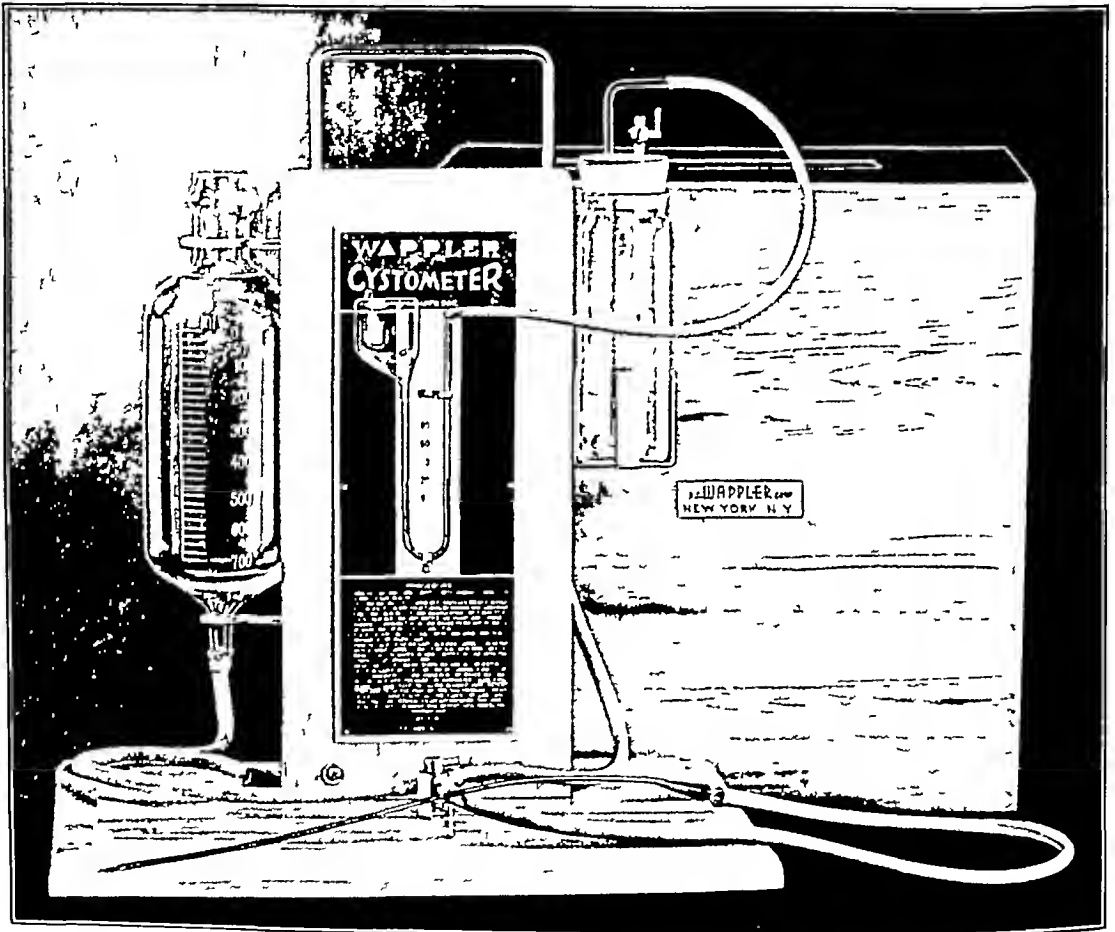


FIG 339—The Muschat cystometer (courtesy of the R C Wappler Corp)

The hypertonic bladder is of the opposite character The rise of the pressure curve is more abrupt than normal The pressure rises rapidly after each 50 to 100 cc of filling, the first desire occurs at 50 or 100 cc , the maximal pressure being extremely high, over 60 mm

The hypertonic bladder, therefore, shows an abrupt rise of the pressure curve, shift of the first desire to urinate is to the left, and very high maximal voluntary pressure (Fig 340)

In making the final diagnosis of the presence or absence of a neurogenic bladder all three factors obtained must be taken into account, namely, first,

the desire to void, the pressure curve and the maximal voluntary pressure. Alteration of one factor alone is not sufficient for diagnosis. The evaluation of the pressure curve alone does not suffice because of the difference in tonus of the detrusor in the normal, ranging from low normal to high normal. Therefore all three cystometric factors must be considered. At least two factors must show very definite alteration before the diagnosis of a neurogenic bladder can be made.

Simulation by Pathologic Conditions. Pathologic conditions of the bladder exist which may simulate the hypertonic or hypotonic bladder. Acute and subacute cystitis, stone in the bladder and tumor give an acute hypertonic curve (Fig. 341) a cystocele, diverticulum, renal reflux and postoperative or postpartum dysfunctions simulate a flat hypotonic curve (Fig. 342).

All of the pathologic conditions just enumerated can be eliminated by a thorough urologic examination, which should always follow a cystometric study. It is better to examine the bladder instrumentally after the cystometric study has been made because of the irritation which an instrumental examination may give rise to thus altering the cystometric findings.

Hypertrophy of the bladder musculature such as seen in obstructions at the bladder outlet, does not simulate any neurologic disease. While the curve is more abrupt and higher than normal, the first desire and maximal voluntary pressure remain within normal limits.

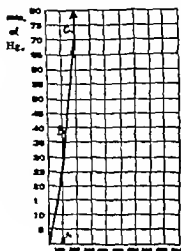


FIG. 340.—Cystometrogram of a hypertonic bladder. The rise of the pressure curve is more abrupt than normal; the shift of the first desire to urinate is to the left and there is a very high maximal voluntary pressure.

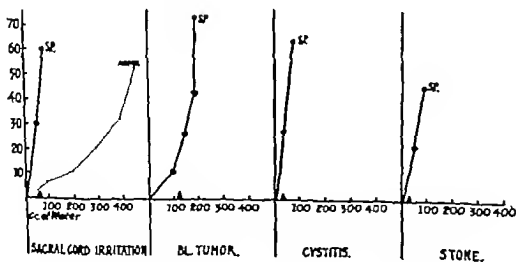


FIG. 341.—Conditions which may simulate a hypertonic bladder.

The possibility of a psychic factor altering the picture of a cystometric study has been studied. It was found that such a subjective psychic factor has no effect upon the ultimate diagnosis. The three factors obtained in a cystometric study are so constant and interdependent in the normal that the change of one factor must bring about an alteration of the other. If a reading is obtained with

only one factor changed, improper technic or simulation by the patient should be suspected. A re-study will invariably bring out the truth, as no one can possibly reduplicate the characteristic combination of all three factors.

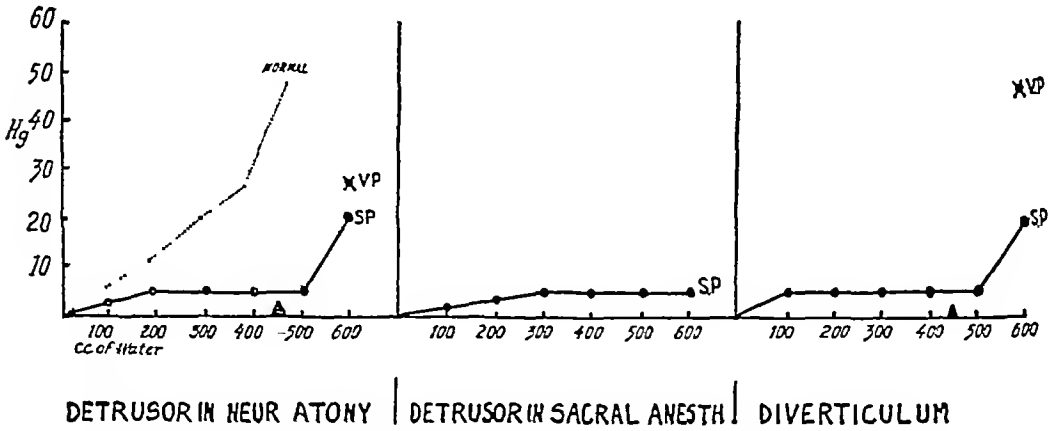


FIG. 342—Conditions which may simulate a hypotonic bladder

Follow-up Studies

CONSTANCY OF CYSTOMETRIC DATA In the normal bladder one is impressed with the constancy of the cystometric data obtained after repeated studies months and even years later. It indicates the existence of a constant characteristic physio-

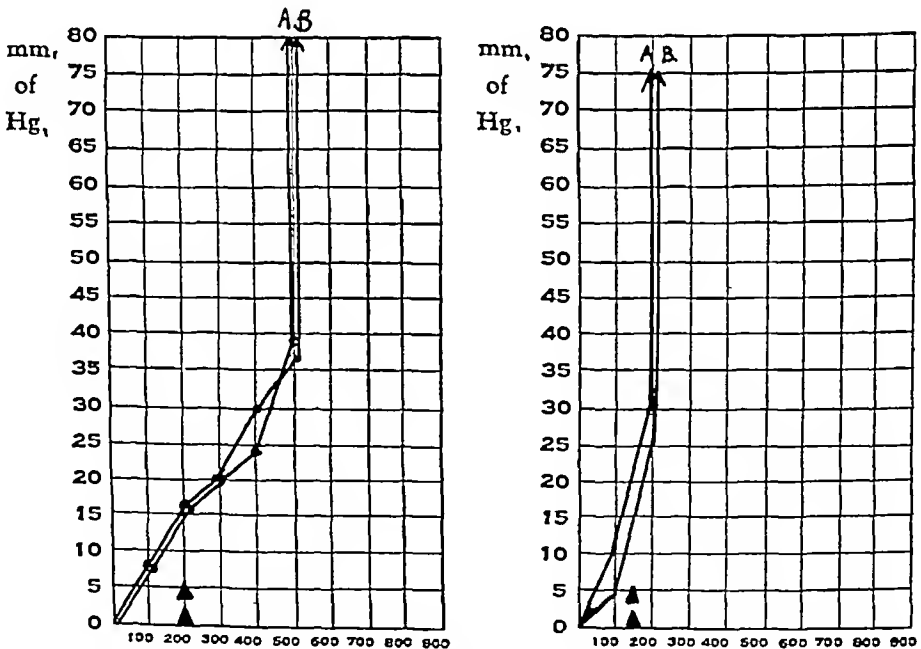


FIG. 343—Left Case of chronic prostatitis, showing constancy of readings taken six weeks apart (A-B) Right Prostatic uropathy with hypertonic detrusor. No change in eighteen months (A-B)

logic rhythm in the normal function of the urinary bladder in every individual (Fig. 343)

DEVIATION INDICATIVE OF NEUROGENIC DISEASE Bearing in mind the constancy of the cystometric data in the normal, any change in this balance is indicative of neurogenic disease. This fact makes cystometry very valuable in

follow up studies to find improvement or regression of the primary disease. Hence, the importance of follow up studies cannot be underestimated clinically. It frequently guides the clinician in undertaking or abstaining from a certain contemplated procedure.

FOLLOW UP CYSTOMETROGRAMS are especially valuable in neurosurgical cases when an indwelling catheter is being employed. The cystometrogram indicates the rate of return of normal function permitting the removal of the indwelling catheter at the optimum time. The early untimely removal of a catheter in such cases often precipitates upper urinary infection owing to ureteral reflux (Fig. 312) presenting clinically as chills and fever which seriously complicate the situation.

FIG. 344

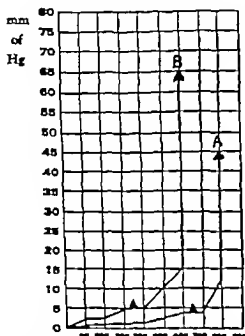


FIG. 345

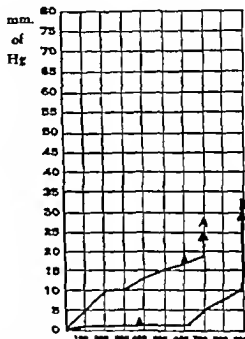


FIG. 344—Contusion of spine with probable hematoma. Retention of urine for four days, great difficulty in urination for the following four weeks. Cystometrogram A, on admission neurogenic bladder of hypotonic type. B six months later marked improvement but still evidence of neurogenic disturbance. No complaints, no clinical evidence of bladder disturbance.

FIG. 345—Tabes dorsalis. Cystometrogram A (August 8, 1934) Neurogenic hypotonic bladder. Cystometrogram B (April 13, 1935) Neurogenic hypotonic bladder. No improvement in spite of antihypertic therapy.

IN SPINAL INJURIES usually complicated by retention of urine the follow up cystometric readings will indicate the rate of retrogression of the edema or the absorption of a blood clot in the cord.

IN MEDICOLEGAL WORK, the question arises as to the condition of the bladder in alleged injury of the spinal cord. One is also anxious to ascertain the progress of repair of the injury. Admitting that an injury to the spinal cord, resulting in temporary bladder dysfunction has occurred, one is able clinically and graphically to establish this fact data which can be used years later to prove the existence of an actual injury as well as to prove malingering.

IN DISEASES OF THE SPINAL CORD the cystometric follow up (Fig. 344) examinations may also be useful. In treating a case of tabes dorsalis with bladder dysfunction one can determine at intervals whether a given therapeutic agent

is bringing about improvement or is of no avail. Thus cystometry may become a definite criterion in the treatment of syphilitic cerebrospinal affections (Fig 345)

Sphincterometry

This is a novel method to determine the tonicity of the external and internal sphincters by means of a rubber tube with a small balloon on its end. The instrument is introduced like a catheter and then withdrawn to lie within the grasp of the internal or external sphincters. The amount of fluid necessary in distending the balloon, until the sensation of pressure is noted by the patient, is used to express the degree of sphincter tonicity. It will become valuable as the experience with this method increases.

TREATMENT

ELECTRICAL STIMULATION

Automatic Bladder After spinal cord injury resulting in partial or complete urinary retention, if catheterization was not resorted to, and in the absence of primary infection, one can expect the spontaneous establishment of an automatic bladder. At first, the bladder overflows at irregular intervals but gradually the appearance of a regular rhythm or periodic overflow is noted. One can materially aid in the establishment of such an automatic bladder by the use of electrical stimulation. Placing the active plate upon the suprapubic area and the indifferent one over the small of the back, the sinusoidal current is applied for 10 minutes at 2-hour intervals. The patient is then instructed to attempt urination and keep the effort up for about five minutes. The electrical apparatus is placed near the patient with the plates constantly in position in order to enable him personally to administer the treatments at regular intervals. It eliminates special nursing care and is usually conscientiously attended to by the patient himself.

The patient never feels that he wishes to void because there is no pain of overdistention. If the latter is present the pain is slight and referred to the upper abdomen. This referred pain is due to the increased intraperitoneal pressure transmitted to the viable segments of the cord where sensation is retained. One should not fear overdistention. It has never caused any ill effects in clean cases.

Once catheterization is resorted to, infection invariably supervenes and the chances for the development of an automatic bladder are very slim. One must await the subsidence of the acute cystitis which is almost certain to follow. Such an acute cystitis is best combated by the use of the indwelling catheter (Fig 101) and urinary antiseptics by mouth combined with acidifiers. One ought not to irrigate the bladder during this acute stage as the slightest overdistention will cause dissemination of the infection. One must keep in mind that in acute cystitis the bladder capacity is diminished considerably and the least amount of irrigating fluid may be sufficient to precipitate an upper urinary infection. The object of acidification of the urine is not meant primarily for the bladder infection, but also to create an unfavorable bacteriostatic medium.

CONTINUOUS BLADDER IRRIGATION

After subsidence of the acute stage of the infection one can resort to continuous bladder irrigation either by means of the Young Shaw decompression apparatus or the Munro tidal drainage outfit.

Occasionally an automatic bladder can be developed by means of these methods

DRUGS

Drugs will either stimulate or depress the detrusor mechanism i.e., either help or hinder in bladder evacuation

Stimulants of the Detrusor Potassium acetate strychnine, pituitrin pilocarpine small doses of epinephrine, cholin hydrobromide mecholyl and ergotamine tartrate

Depressants of the Detrusor Cocaine morphine barbiturates ephedrine atropine and epinephrine in large amounts.

In using drugs in the neurogenic bladder of the hypotonic type one must first of all keep in mind the stimulation of the weakened detrusor muscle either locally or by systemic reaction. We have found irrigations with increasing strength of solutions of silver nitrate beginning with 1 to 5000 and gradually increasing the strength to 1 to 500, to be of definite value in increasing the tonus of the detrusor

Strychnine is employed in large doses with benefit, not only to the bladder but also as a general tonic.

Potassium acetate has been found to be of much value as proven cystometrically by greatly increasing the detrusor tonus. It is especially valuable in postoperative retention. It is given orally 15 cc. of 1 to 15 solution of Liq. Potassium Acetate every half hour for eight doses. One is thus able to reduce the percentage of postoperative catheterizations from 90 per cent to 28 per cent.

Mecholyl This drug is at present the best for detrusor stimulation. If taken orally 100 mg. 4 to 6 times daily it actually causes tonic contractions of the bladder wall musculature and aids greatly in emptying the bladder.

I have seen a tabetic bladder filled with over 1000 cc. of urine suddenly empty after the second oral administration of 100 mg. of mecholyl.

Ergotamine Tartrate Four mg. daily of this drug by mouth is very effective in reducing the residual urine in the tabetic. It increases the detrusor tonus very markedly as proven by cystometric study.

Antiluetic therapy will improve the tonus of the detrusor in some cases in others it will leave it unchanged.

The hypertonic bladder with concomitant incontinence does not respond to any drugs either locally or systemic. There is no treatment for this type of dysfunction. Bladder irrigations are contraindicated because of the danger of disseminating infection. Fortunately this type of neurogenic bladder is much less frequently encountered than the hypotonic type. Improvement will only follow the removal of the cause in the spinal cord or brain. Palliative measures are indicated such as heat applied locally, antispasmodics and even morphine if the pain persists.

SURGERY

Resection of Posterior Vesical Lip In the progressive and late stages of a neurogenic bladder of the hypotonic type a greatly enlarged posterior vesical lip will be found which resembles a well developed median bar of commissural hypertrophy. This is due to hypertrophy of the trigonal muscle in its effort to open the bladder outlet. The hypertrophy increases greatly until it becomes an additional obstruction to the outflow. In many cases of stationary neurological diseases this hypertrophied musculature can be removed by punch operations with excellent functional results. Urination becomes greatly improved, and the residual is greatly reduced. This operation has also been recently advised, with apparently good results, in cases of relaxed sphincters.

Presacral neurectomy for hypotonic bladder has been done in numerous cases. In some, recovery was permanent, in others the operation was only of temporary value. It undoubtedly increases the expulsive force of the bladder.

Cystostomy with six to twelve weeks of bladder rest is also advocated, followed by careful training to urinate "by the clock."

Vesicoclysis in hypertonic bladder was advocated by Learmonth who achieved good results in some cases. The operation consists of stripping the bladder of its nerve attachments, especially in its posterior inferior aspect.

PART FIVE

URETER

CHAPTER	PAGE
29 ANOMALIES OF THE URETER	535
30 INJURIES, STRICTURES OTHER INFECTIONS OF THE BLADDER	552
31 CALCULI AND TUMORS OF THE URETER	566

ORIENTATION

The ureter, like the urethra, is only a potential canal. Its lumen, when the folds of the mucosa are in contact with each other, is reduced to a minute slit. The ureter possesses an autonomic, i.e. independent nerve supply, so that when a wave of peristalsis starts at one end it passes progressively to the other extremity. At times, these waves are of such intense character that a localized temporary narrowing of the lumen, a so-termed "spasm," may result. It is important to keep this in mind lest such a constriction, as seen in a ureterogram, be interpreted as due to a permanent narrowing in the form of a stricture. Anomalies of the ureter are far more common than those of the bladder or urethra. Some of these anomalies appear in the form of a permanent narrowing of the lumen and give rise to a hydro-ureter or hydronephrosis. With the aid of both excretory and retrograde urography, the recognition of ureteral anomalies has been greatly facilitated. This is especially true of an anomaly, termed ectopic ureteral ending. In such patients, the ureter instead of ending at one of the angles of the base of the trigone, as shown in Figure 41, terminates abnormally. Such an ectopic ending may occur in the bladder or in the urethra in both sexes, in the cervix uteri, vagina or vestibule or rarely in the seminal vesicle, vas or ejaculatory duct. The knowledge of such abnormal endings of the ureter has led to the search for an ectopic ureteral orifice in all cases of persistent incontinence in the female and in cases of pyuria of obscure origin in both sexes.

Injuries of the ureter have become far more frequent as the result of radical operations for cancer of the uterus and as a complication of other major gynecological procedures. Their early diagnosis with the aid of excretory urography and ureteral catheterization has been followed by a decided lowering of the mortality. The question of the incidence of ureteral strictures is now greatly clarified as compared to a decade ago. An evaluation of the formerly employed methods of diagnosis has been followed by a demand for more objective evidence in the form of ureterograms showing persistent narrowing at the level of the suspected stricture, so as to exclude the possibility of a transitory constriction due to ureteral spasm. It cannot be denied that ureteral strictures of both congenital and acquired origin exist but their incidence is far less than was formerly claimed.

Many tumors of the ureter and bladder represent implantation metastases from a primary epithelial neoplasm of the renal pelvis. A relatively large number of cases, however, have been reported of tumors arising from the mucosa of the ureter. Hematuria, an obstruction on ureteral catheterization and, particularly, a filling defect in the ureterogram have permitted a correct pre-operative diagnosis.

It is generally agreed that the majority, if not all, calculi found in the ureter have formed primarily in the kidney, but it is possible that a few may develop at the level of a stricture. The radiographic diagnosis of ureteral calculi which yield a shadow presents no difficulties, but that of nonopaque calculi requires much more care, lest their recognition be overlooked. The treatment of ureteral calculi has swung toward the nonoperative side during the past two or three decades. At least 75 per cent can be delivered by cystoscopic manipulation, although one cannot persist too long in using such a nonoperative method lest a severe, often fatal infection of the corresponding kidney take place. A few urologists go so far as to advise ureterotomy for every case of ureteral calculus, but this is not the general opinion. If the calculus is relatively large, over 1 cm. in diameter and located above the point where the ureter crosses the pelvic vessels, nonoperative methods of delivery are contraindicated. This is also true of cases of acute pyelonephritis complicating a ureteral calculous obstruction, in which the passage of a catheter beyond the level of impaction is not followed by immediate cessation of the symptoms of acute renal infection. In more chronic types of infection, a nephrostomy may render conditions more favorable for instrumental delivery.

CHAPTER 29

ANOMALIES OF THE URETER

ANOMALIES OF CALIBER AND FORM

CONGENITAL STRICTURE
CONGENITAL VALVES OR FOLDS
CONGENITAL DILATATION WITHOUT DEMONSTRABLE OBSTRUCTION
CONGENITAL DIVERTICULA
SPIRAL TWISTS (TORSION)
KINKS

POST-CAVAL URETERS
ANOMALIES OF ORIGIN AND TERMINATION
ANOMALIES OF ORIGIN
BLIND-ENDING URETERS
ECTOPIC ENDING
URETEROCELE
ANOMALIES IN NUMBER

These may be classified as

Anomalies of caliber and form

- 1 Congenital stricture.
- 2 Congenital valves or folds
- 3 Congenital dilatation without demonstrable obstruction
- 4 Congenital diverticula.
- 5 Spiral twists (torsion)
- 6 Kinks
- 7 Post-caval ureters

Anomalies of origin and termination

- 1 Anomalies of origin
- 2 Blind ending ureters
- 3 Ectopic ending
- 4 Ureterocele.

Anomalies in number¹

- 1 Absence (agenesis)
- 2 Hypoplasia.
- 3 Double or triple ureters.

ANOMALIES OF CALIBER AND FORM

1 Congenital stricture

PERSISTENCE OF FETAL CONDITIONS Seitz Byton Robinson Hamann Caspar and others have shown that the ureter in all mammalia during fetal and post uterine life normally has certain (Fig 346) more or less constant points of narrowing, which are (a) at the ureteropelvic junction (b) at the ureterovesical junction and (c) where the ureter crosses the iliac vessels. These three points of narrowing become more marked toward the end of fetal life.

LOCATION ETC OF CONGENITAL STRICTURES As a rule the levels at which they are found correspond to the two more constant points of narrowing in the fetus viz at the ureterovesical and ureteropelvic junctions (Fig 346). They may be unilateral (Fig 346) or bilateral at the same or at different levels ureterovesical on one side and ureteropelvic on the other or vice versa.

Congenital strictures may be of broad caliber or almost impassable. The

¹ Anomalies in number are taken in Chapter 3 under Congenital Solitary Kidney Hypoplastic and Double Kidneys respectively.

effect on the upper urinary tract is like that of any continuous obstruction, viz, the development of a hydroureter and hydronephrosis (Fig 370)

CLINICAL PICTURES These vary according to whether infection has supervened or not, they are

1 Cases in which the outstanding symptom is a tumor, uni- or bilateral, in the kidney region

2 Cases in which there are attacks of colicky pain along the course of the ureter



FIG 346—Autopsy specimen of urinary tract of ten day old infant. Note narrowing on left side just below renal pelvis, again at crossing of iliac vessels and just before entrance into the bladder. Note marked spindle like dilatation in pelvic portion of the ureter and again in lumbar portion.

3 Cases in which the child has a marked pyuria, cachexia, recurrent or persistent fever

DIAGNOSIS In some children, the presence of a tumor in the upper abdomen attracts the attention of the mother or family physician. In others, the pyuria with or without concomitant fever, marasmus, etc., point to the urinary tract as the source of the symptoms. Unfortunately, many cases in the second group go on for months or years without being examined. The necessity of a thorough urologic study (see Chapter 10) in every child presenting one of the above clinical pictures cannot be too strongly emphasized. Excretory urography can be of much service if there still exists some renal function.

TREATMENT This should be conservative, i.e., dilatation with gradually increasing calibers of ureteral bougies, beginning with a No 4 F. Campbell has had constructed a 17 F. cystourethroscope which will permit the passage of a 10 F. Garceau catheter, which gives adequate dilatation for a child up to 12 years of age. The most favorable cases are those in which the stricture is at the ureterovesical junction. Following the dilatation, a lavage of the renal pelvis can be carried out with a 1-500 or 1-2000 solution of nitrate of silver, varying in strength according to the age of the child. Kretschmer reports some excellent

results after meatotomy of the vesical orifice of the ureter in strictures at that level

In congenital strictures at the ureteropelvic junction with marked hydronephrosis only a nephrectomy can as a rule be considered, provided that the function of the opposite kidney justifies such a step. Plastic operations for correction of strictures at the upper end of the ureter are not well tolerated by children and are very difficult from a technical point of view.



FIG. 347.—Urograms from seven months' old girl presenting symptoms of severe renal infection due to neurogenic dysfunction.

A. Note dilated right renal pelvis and ureter. Between these, a complete reduplication or kink of the ureter is to be seen. Note sudden narrowing at lower end of ureter due to stricture formation.

B. Opposite side, showing more uniform dilatation of renal pelvis and ureter with only slight narrowing at their junction. Note much wider lower ending of this ureter.

2 Congenital Valves or Folds.

Congenital valves or folds of mucous membrane projecting into the ureteral lumen have been found in the fetus and new born by Woelfler, Englisch, Robinson and Gerard. According to the last named author they occur in 5 per cent of all necropsies of fetuses and new born children. They are usually found at the levels of the normal narrowings of the ureters. The only report of a clinical case in which such a valve caused ureteral obstruction is that of Gottlieb (Zeit. Urol. Chir. 1929, 26, 301). A large hydronephrosis was found at operation due to a valve in the uppermost portion of the ureter. Unfortunately, no drawing of the specimen accompanied the report, so that it is uncertain whether the valve was primary or secondary to a kinking of the ureter by the hydronephrosis.

3 Congenital Dilatation of the Ureters without Mechanical Obstruction.

So many cases of this type have been published that the existence of ureterec

tasis, without the presence of a distal obstruction, can no longer be questioned. Many, like a case (Fig 347) reported by one of us (Amer Jour Dis Children 1929, 38, 1006) are due to faulty neuromuscular function. Examination in this case showed widely gaping ureteral orifices and the existence of a bilateral vesico-ureteral reflux when a cystogram was made. Similar findings are reported by Sargent, Bouchard, Eisenstaedt and others. The condition may be unilateral but is usually bilateral. The ureters form a huge sausage-shaped mass with marked tendency to kinking (Fig 347). In our case, such a kink appeared to obstruct the

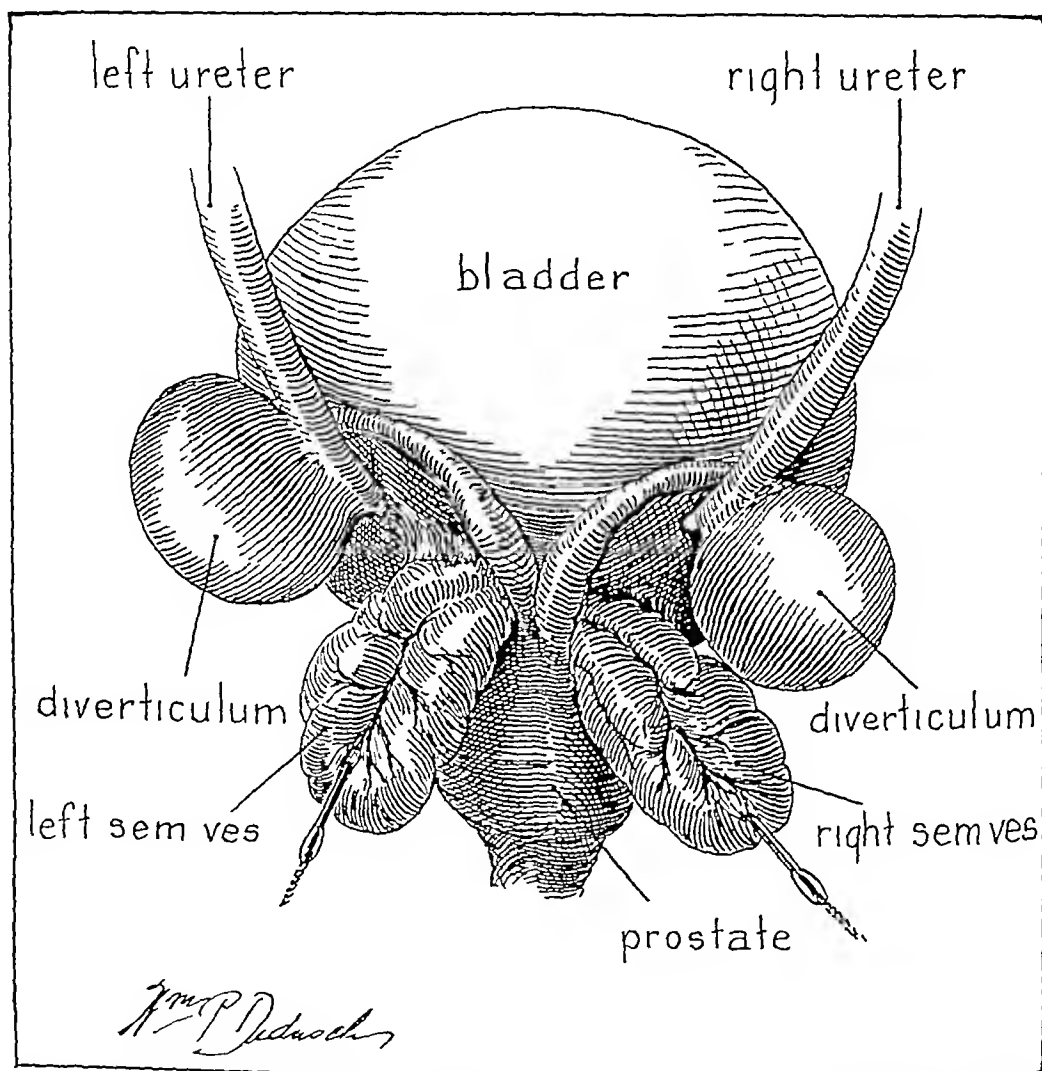


FIG 348—Case of bilateral ureteral diverticulum. Diagrammatic sketch of conditions found at operation (Courtesy of Dr N P Rathbun)

passage of urine and temporary improvement followed a lateral anastomosis of the two loops of the kink.

THE CLINICAL PICTURE is that of pyuria and chronic urosepsis. Without a urologic examination the condition cannot be distinguished from that due to a congenital ureteral stricture. As to treatment, obstructive sphincter spasm at the vesical outlet must be excluded. If this has been done, only frequent lavages of the upper urinary tract are of any avail.

4 Congenital Diverticula

In a recent paper (Am Jour Surg 1936, 34, 385), Campbell reported 24

clinical and necropsy cases (including a clinical case of his own) In addition, cases have been published by Handl Schmutte Gottlieb and Brown, making a total of 28 Peper's case is the only one in which multiple bilateral diverticula and Rathbun's the only one in which single bilateral (Fig 348) diverticula were found The embryologic origin is not clear Some may be of acquired origin secondary to a ureteral obstruction as in Peper's case in which a sarcoma whose location is not given was found in a man 47 years of age

A diverticulum may be present throughout life without giving rise to symptoms until infection or calculus formation occurs, the pyuria and pain resembling that of a ureteral obstruction appear The diagnosis has been made in a number of the reported cases by the coiling up of opaque catheters in the diverticulum and confirmed by ascending (retrograde) urography Diverticulectomy has been done in 7 cases and nephroureterectomy in an equal number The latter operation may be unavoidable if adhesions prevent excision of the sac.

5 Spiral Twist or Torsion

This is the result of failure of the ureter to rotate with the kidney and is followed by ureterectasis and pyelectasis Typical cases have been reported by Baetzner (Fig 349) Campbell Block and Eisendrath In Block's case (Zeit Urol Chir 1924 14 221) there were multiple twists in the others only a single one (Fig 349)

6. Congenital Kinks

URETERAL KINKS There is still considerable discussion as to whether true congenital kinks occur Many urologists contend that ureteral kinks are as a rule a sequence of (a) abnormal mobility of the kidney with resultant folding up (usually close to the renal pelvis) of the ureter or (b) of a redundancy of the ureter so that there is similar folding up or kinking (Fig 146) There are some who claim that every kink whether of congenital or acquired origin must give rise to symptoms the most prominent of which

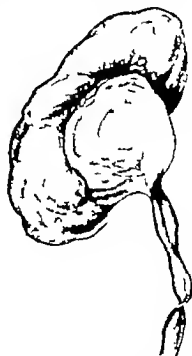


FIG. 349.—Congenital spiral twist of the ureter with resultant hydronephrosis (Baetzner's cases)

is pain either in the form of a dull ache or more severe colicky pain. In our opinion there are many cases without abnormal mobility of the kidney in which there is normally an unusual length or redundancy of the ureter so that it folds up (Fig 146) That such a kink of congenital origin can give rise to a clinical picture (pain etc) is an unsettled question One can be easily deceived as to the presence of a kink unless the catheter is completely withdrawn before the ureterogram or plain exposure is made (Fig 147) because the catheter itself in a redundant, i.e. long loosely held ureter can easily cause an artificial kink as shown in Fig 147 If there are symptoms of renal infection on the side upon which the kink is located, it is not to be denied that there may be a direct relation between the two

One should always examine (a) as to the possible presence of a movable kidney with resultant kinking of the ureter and (b) exclude the kinks at the ureteropelvic junction which are secondary to abnormal ureteral inserts or acces-

sory vessels. The use of combined radiographic and cystoscopic tables in which films can be taken with the patient first in horizontal and then in almost upright position (Fig 135) has thrown much light on the relation of ureteral kink to abnormal mobility of the kidney.

It is as difficult to say that a large number of kinks of the ureter are of congenital origin, as it was in the case of ureteral strictures, except in infants and children. When one examines a specimen of hydronephrosis after nephrectomy, in many cases it is equally impossible to determine whether the kink or folding up of the ureter (with its separate portions enclosed by a membrane of adhesions as shown in Fig 351), was primary and the hydronephrosis secondary, or vice versa.

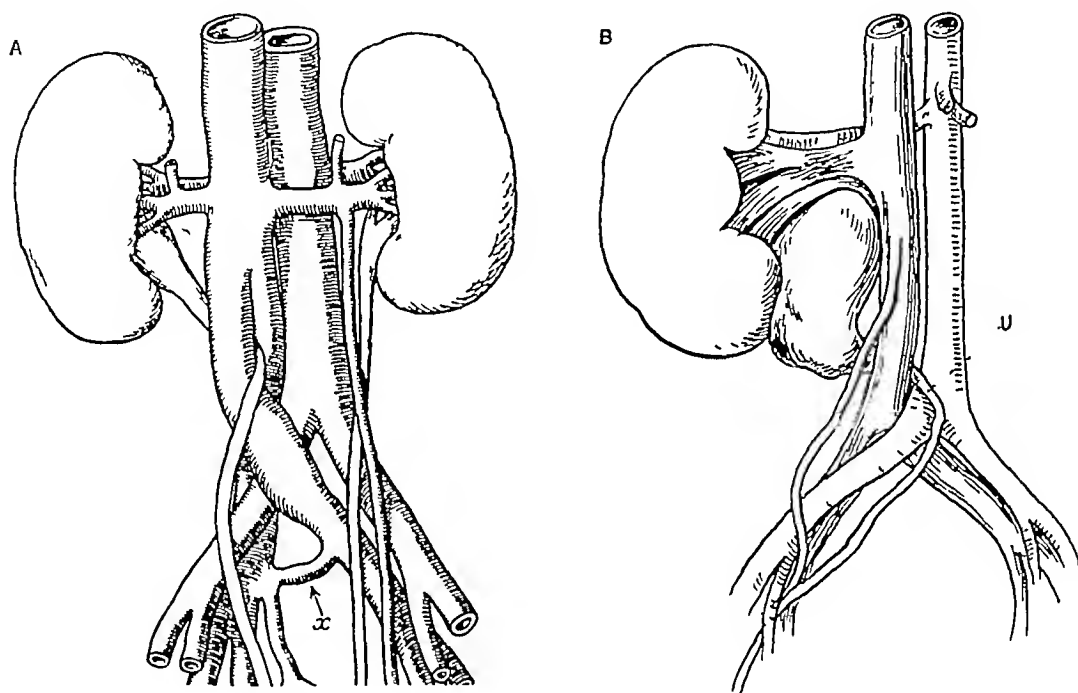


FIG 350—Necropsy specimens from cases of postcaval ureter. A Drawing of specimen of E. von Gierke's case (*Zeit Urol Chir*, 1928, 25, 280). B Drawing from photograph of hydronephrosis due to postcaval course of the right ureter. K. Kengyel's case reported (*Zeit Urol Chir*, 1928, 25, 417).

Thompson and Bumpus (*Jour Amer Med Assn* 1930, 94, 771) found in looking over a number of urograms showing a ureteral kink, that a succeeding film would not reveal the presence of a kink. They believe that many are artificially produced when the patient, before exposing a film, is instructed to "take a deep breath and hold it." If a film is made during expiration the kink disappears. They were able to demonstrate this in three cases. A kink should not be regarded as of clinical importance unless accompanied by a hydronephrosis.

7 Post-Caval Ureters (See Fig 350)

This is due to the persistence of the posterior cardinal vein caudal to the renal veins. The first case was observed at the necropsy of an infant several weeks old and reported by Hochstetter. A second observation was made at necropsy of a man 55 years of age and reported by Fritz Kolisko in 1908, and a third one by Gladstone. Roger C. Graves noted the existence of this anomaly

in cats in 1922, and the embryologic side of the question was studied by McClure and Butler in 1925

Derbes and La Nasa (*Urol and Cut. Rev.* 1937 41 172) have collected 18 observations, 14 made at necropsy and 4 clinically

The kidney, during its migration in a cephalad direction in the embryo, lies for a time behind the vena cardinalis the primitive vein of the posterior portion of the body. An anastomosis forms from the level of union of the iliac veins to that portion of the vena cava which is cephalad to the kidney. The primitive vena cardinalis disappears and this anastomotic vein becomes the permanent vena cava inferior. If however, the right postcardinal vein fails to atrophy. It forms the main channel from which the vena cava develops and the ureter is obliged to pass behind it (Fig. 350)

In the case reported by Glerke (*Zelt. Urol Chir.* 1928, 25, 279) there was a high division of the common iliac veins so that the right ureter passed behind the right common iliac instead of behind the vena cava.

Of the four clinical cases thus far reported, the preoperative diagnosis was the same, viz hydronephrosis in all. The actual cause of obstruction (Fig. 350) was found at operation. Randall is of the opinion that a peculiar 'buttonhook' deviation of the opaque catheter may prove to be a valuable diagnostic sign in the future

ANOMALIES OF ORIGIN AND TERMINATION

1. Anomalies of Origin

The renal pelvis and its calices develop as an expansion from the upper end of the embryonic ureter. The latter under normal conditions, lies at the most dependent portion (Fig. 145) of the renal pelvis an anatomical arrangement which renders it easier for the peristalsis of the musculature of the wall of the renal pelvis, to propel the contents of the pelvis into the upper opening of the ureter. When this orifice is located at a point which is at a higher level (as the result of faulty development of the renal pelvis) there is interference with the escape of urine into the ureter. The terms anomalies of origin or faulty origin or faulty insertion, are therefore incorrect from an embryologic point of view because it gives one the impression that the ureter develops from the embryonic renal pelvis instead of the opposite i.e. that the renal pelvis in reality develops from the upper end of the ureter. It is not clear why in some individuals the junction of the ureter and renal pelvis should be at a higher level. One might theorize that the ureter develops in a cephalad direction more rapidly than the renal pelvis and hence its upper end comes to lie at a higher point. This would serve to explain some of the cases in which the ureteropelvic junction is relatively high or on the posterior instead of the mesial aspect of the renal pelvis. These two constitute the most common forms of so-called faulty origin or insertion. There are, however, cases like those of Manasse in which the ureter follows along the entire anterior (ventral) aspect of the renal pelvis of a completely rotated kidney in order to enter its posterior (dorsal) aspect. We are of the opinion that the valve or spur formation or kinking of the ureter so often seen in cases of high insertion of the ureter is secondary i.e., as the fluid accumulates in the renal pelvis a pouch is formed (Fig. 351) at its lowermost portion. This results in an

exaggeration of the angle which the pelvis and ureter form with each other so that a shelf or spur is formed between the two, which becomes more and more marked as the pelvic distension increases. The folds which the ureter shows (Fig 351) after emerging from the renal pelvis, held together as these folds are by thin membranous adhesions, we believe, are also secondary to the obstruction?

If such a view be accepted, we believe it will greatly simplify comprehension of the question. Many text-books hold that there are in addition to high insertion, valves at the ureteropelvic junction of congenital origin and also a form

FIG 351



FIG 352

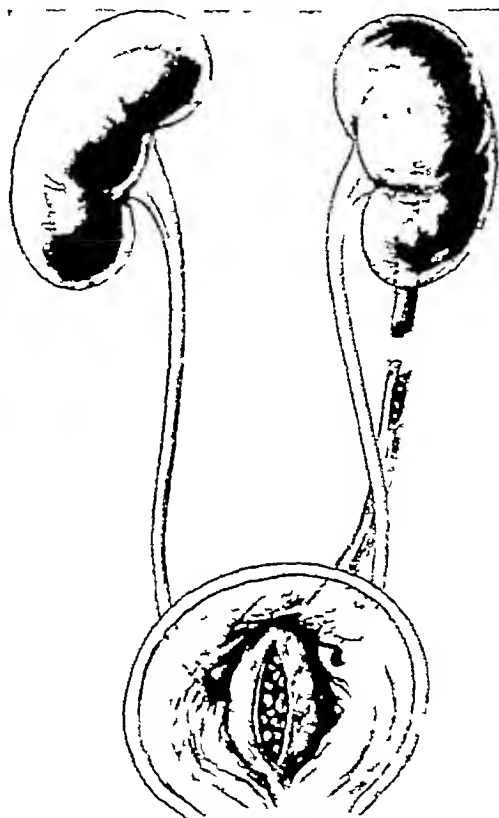


FIG 351—Advanced hydronephrosis apparently due to faulty ureteral origin. The membrane in which the ureter was enclosed and firmly held to pelvis, has been reflected to show ureteral insert more distinctly. No previous operation such as pyeloplasty had been performed.

FIG 352—Double ureter (left). The second ureter ends blindly above and below. Its lower end greatly dilated and filled with calculi. A few calculi also found in middle portion of the accessory ureter (Clairmont).

of invagination into the renal pelvis of the upper end of the ureter. Both are mentioned as primary conditions and equally responsible with high "insertions or origins" of the ureter for the resultant hydronephrosis. We desire to repeat that we feel that the high location of the ureteral orifice is primary and that all the other findings are secondary.

CLINICAL IMPORTANCE The relation of congenital hydronephrosis to abnormally high location of the outlet of the renal pelvis has been known for many years. There are a large number of reported cases in which this anomaly was

² See illustration of such a case in Chapter 53 following pyeloplasty, fifteen years before, for stricture at ureteropelvic junction.

either found at autopsy or at operation. Many forms of plastic operations for the correction of the condition have been attempted.

Based on these observations and with our knowledge greatly added to by ureteropyelography we can today divide the cases as encountered clinically into two groups.

1 THOSE IN WHICH PAIN EITHER CONSTANT OR IN THE FORM OF RECURRENT COLICS IS THE OUTSTANDING FEATURE

2 THOSE IN WHICH ALL OF THE WELL KNOWN FINDINGS OF A HYDRONEPHROSIS ARE PRESENT

The first group are recognized chiefly by the radiographic findings viz. the ureter instead of being a continuation of the most dependent portion of the renal pelvis proper (Fig. 145) is found at a higher level either on the mesial or posterior aspect of the pelvic shadow. The number of cases of this variety which have been reported is still quite small.

In the second group one is only able to make a diagnosis of some obstruction at the pelvic outlet. The opaque medium can only be injected as high as the ureteropelvic junction in some of these cases. In others, one can fill the entire pelvis but even here it is usually impossible to make an exact diagnosis before operation as to the type of obstruction. Of great value in such cases is our ability through the aid of serial roentgenographic exposure following excretory urography to observe the delayed emptying time of the renal pelvis.

As to the operative relief of the cases in both (viz. the pain and tumor) groups success or failure is dependent we believe more upon the question of the degree of accompanying infection than upon the particular type of plastic operation.

2. Blind Ending Ureters

It is necessary to exclude under this heading cases of congenital solitary kidney in which a ureter and ureteral orifice are found on the agenesis side but the ureter ends blindly. In the older literature many of the reported cases were in reality examples of a different congenital anomaly ureterocele (Fig. 355) which are not blind ending ureters because a minute orifice allows the escape at intervals of the urine. Some of the reported cases in which a cystic protrusion was found in the vaginal wall or posterior (male) urethra were described as blind ending ureters. They should have been termed cases of ectopically ending ureters because in many the cystic protrusion had an opening from which urine escaped. If a cystic dilatation exists at the lower (most common) or upper end or at both ends of a blind ending ureter it remains closed unless a spontaneous perforation takes place or it is operatively (at lower end) opened.

THE FOLLOWING VARIETIES OF BLIND ENDING URETERS have thus far been reported

a Ureter of a single³ kidney ends blindly below. This is often found in cases of congenital renal hypoplasia (see Chapter 32).

b Ureter of upper or lower half of a double³ kidney ends blindly above and below (Fig. 352). In the latter case the lower blind end was filled with calculi.

c Ureter of one half of a double kidney on one or both sides ends blindly below.

³By single kidney is meant one with a single pelvis and ureter while by double kidney is meant one with two pelves and two ureters.

d Cases in which two ureteral orifices are found on one side of the bladder but one of the two corresponding ureters ends blindly

e Cases like those reported by Lau and Henline (Jour Amer Med Ass'n. 1931, 96, 587) and by Chwalla in which three ureteral orifices were found

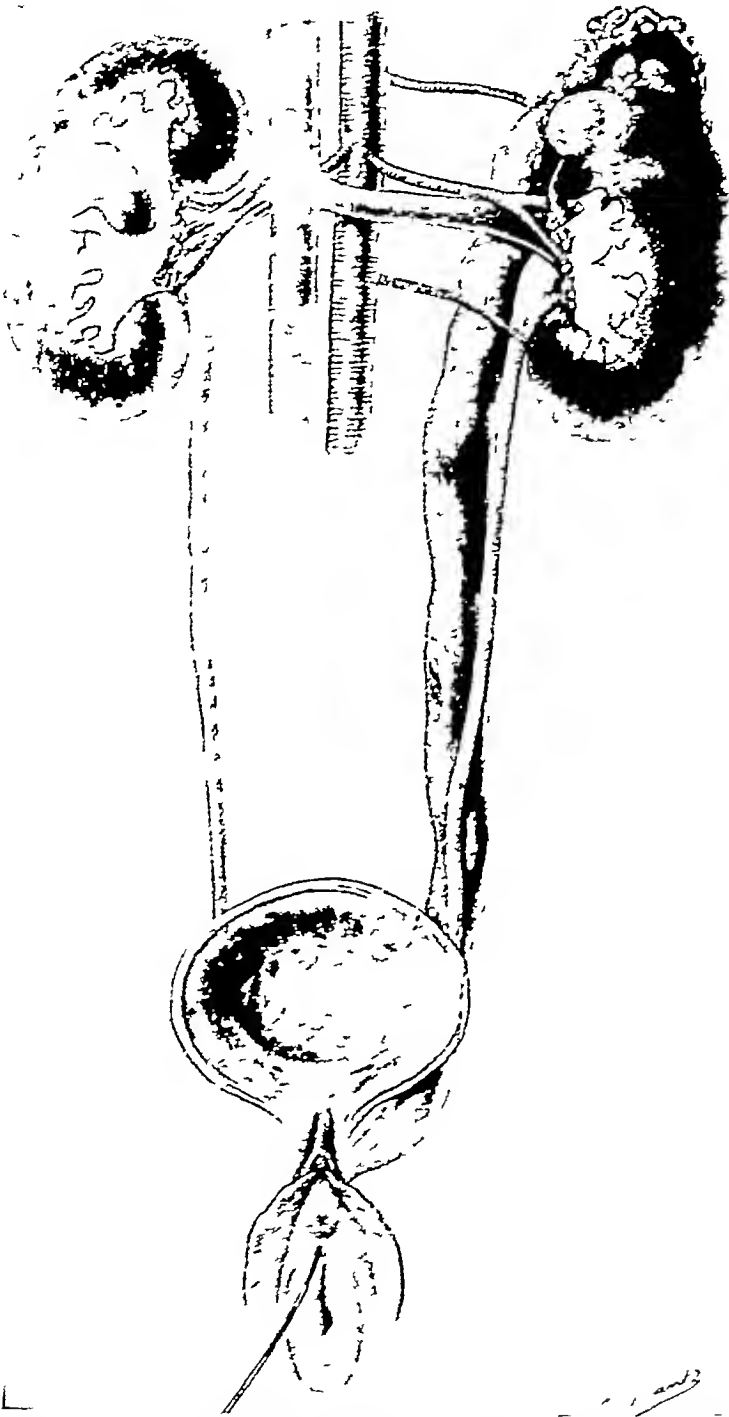


FIG 353—Ectopic ending of the ureter of the upper half of a left double kidney in the vestibule, just below the external meatus (Courtesy of Dr E Papin) Note ureteral catheter inserted into the ectopic ureteral orifice

on one side of the bladder but one of the corresponding three ureters ended blindly

THE MOST COMMON LOCATIONS of the lower end of blind ending ureters is of

considerable clinical interest, because if infection by the hematogenous route takes place, the resultant symptoms may simulate closely those of other lower abdominal acute or chronic conditions. The lower end may be found

In the true pelvis close to the distal portion of a normal or bicornuate uterus

In or behind the posterior wall or floor of the bladder

In the anterior vaginal wall or in the posterior (male) urethra

A Harris (Jour Urol 1937 38 442) as well as Sisk and Kundert (Jour Urol. 1937 38, 261) have recently reported cases in which a diagnosis of blind ending ureter was made by ascending urography

There are no typical clinical pictures for this ureteral anomaly. When infection supervenes removal of the blind ending ureter and corresponding half of the double kidney heminephrectomy may be necessary as was done in Allenbach and Boeckel's case (Jour d'Urol 1926 21 46)

3 Ectopic Ending of One or More Ureters

Instead of ending as it does normally at the angle of the trigone which corresponds to that of the kidney from which it arises an abnormal termination of the lower end of the ureter may occur in both sexes.

Up to 1937 we have been able to find the reports of 282 cases, of which 82 were in males and 200 in females

ORIGIN

a. IF THERE IS ONLY ONE ECTOPICALLY ENDING URETER It may be that of a single normal kidney or that of the upper or lower half of a double kidney. Cases of the ureter of an ectopic congenital solitary or hypoplastic or horseshoe kidney ending ectopically are comparatively infrequent

b. IF THERE ARE TWO ECTOPICALLY ENDING URETERS they may be

1 The ureters of two single (normal) kidneys

2 A ureter from the upper or lower half of a double kidney on each side of the body

c. ONE URETER may correspond to a single kidney of one side and the other ureter from the upper or lower half of a double kidney on the opposite side of the body

d. THE TWO URETERS correspond to the two halves of a double kidney on one side of the body

Location of endings and number of cases (up to July 1 1937)

Male bladder—no reported cases.

Male urethra—53 cases

Seminal vesicles (Fig 354) vas deferens and ejaculatory duct—29 cases.

Female bladder—11 cases

Female urethra—46 cases

Vestibulum vaginae—88 cases. (Fig 353)

Vagina uterus and Gaertner's duct—55 cases.

It is of interest to note where the endings were located when two ureters were involved

Both in male urethra (Obici) both in female urethra (Kretschmer and Heany Thilow Morris) both in vestibulum vaginae (Spitzer and Walio Haselhorst Egorow) both in respective halves of double vagina (De Paul) one in

For definition of terms "single" and "double" kidney see the chapter on Anomalies of the Kidney

vagina and other in vestibule (Ottow), one in vagina and other in bladder (von Rihmer), one in vagina and other in urethra (K Schroeder), one in female bladder and other into urethra (Judd)

CLINICAL ASPECTS IN THE MALE ECTOPIC ENDING IN POSTERIOR URETHRA
Of the 53 cases, only 15 were clinical In 11 of the 15, the search for a source of pyuria led to the discovery of the ectopic opening by urethrocystoscopy and confirmation by ascending urography In Day's second case a calculous shadow in the true pelvis was found to lie in a ureter which ended in the posterior urethra

ECTOPIC ENDING IN SEMINAL VESICLES, VAS DEFERENS AND EJACULATORY DUCT

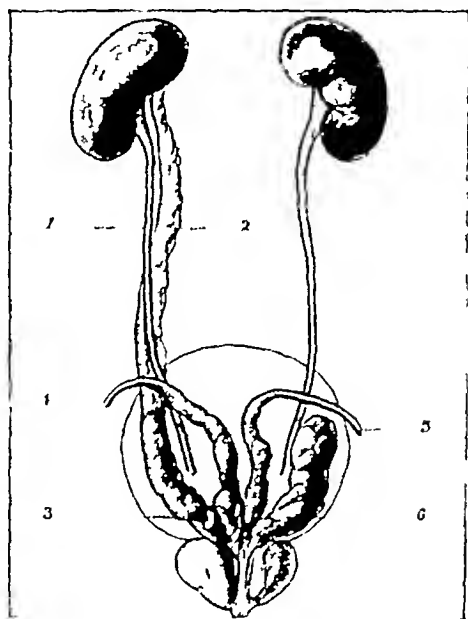


FIG 354—The ureter from the upper half of a double kidney ends in the seminal vesicle of the same side (Erhardt Schmidt's case)

These were all necropsy observations In 16 the ureter ended in the seminal vesicle, in 7 in the vas deferens and in 6 in the ejaculatory duct

CLINICAL ASPECTS IN THE FEMALE The chief complaint in most of the clinical cases was incontinence since birth The dribbling of urine, when the ureter ends in the vestibule or vagina, is continuous, thus differing somewhat from the cases in which one or two ureters end in the female bladder or urethra Here, the patient can void, but there is incontinence in the intervals between spontaneous evacuations of the bladder

a INSPECTION

The vulva and vestibule on all sides of the external urethral meatus should be carefully inspected The ectopic ureteral orifice is, as a rule, located in the lateral or inferior quadrants (Fig 353) of the circle whose center is formed by the urethral meatus Often after having asked the patient to void, and the bladder is empty, one can see a few drops of urine escape at intervals from an ectopic orifice near the urethral meatus

Search for ectopic ureteral orifices in both sexes is simplified by injecting intravenously 5 cc of an 0.4 per cent solution of indigo carmine

If an opening has been found which is suspected to be the orifice of the ectopic ureter, an attempt to insert a small caliber ureteral catheter can be made

In a certain number of reported cases a few drops of urine escaped from the catheter and the latter could be inserted far enough to obtain a satisfactory urogram enabling a diagnosis to be made not only of the length and contour of the ectopic ureter but also whether it was the ureter of a simple or of one half of a double kidney. If more than one ectopic orifice is found the same diagnostic methods enable one to determine whether one ureter on each side of the body corresponds to a single or one half of a double kidney or finally whether there are two ectopically ending ureters both of which correspond to the two halves of a double kidney.

Much patience is required in the search for an ectopic ureteral orifice in the vagina. Every portion of the anterior wall and lateral fornices must be carefully inspected to detect the escape of a few drops of clear or turbid (in infected cases) urine. The same is true for ectopic orifices in the female urethra. Although the McCarthy cysto-urethroscope has rendered invaluable services in the search for ectopic ureteral orifices in the male urethra this is not true in the case of the short female urethra. Cystoscopy alone suffices to detect an ectopic ureteral orifice located near the vesical neck.

b. URETHROCYSTOSCOPY AS A DIAGNOSTIC METHOD

To sum up the urethrocytoscopic findings we may encounter

(a) *Two Normally Located Orifices* One should always suspect that the ectopic ureter corresponds to one half of a double kidney on one side or. If there are two ectopic ureteral orifices that one of them corresponds to half of a double kidney on one side and the other to half of a double kidney on the opposite side.

(b) *Single orifice* (normally located) in bladder may correspond to a single kidney of one side the ectopic ureteral orifice corresponds to a single kidney of the other side or as rarely occurs to half of a congenital solitary kidney with two pelves and two ureters.

(c) *Both Orifices Absent in Bladder* Either the ectopic ureteral orifice corresponds to a congenital solitary kidney or there are two ectopic ureteral orifices corresponding to a ureter on each side of the body leading to a kidney of the simple type.

(d) *Two Orifices on One Side and None on the Other Side of the Bladder* This evidently indicates the presence of a double kidney on the side where the two orifices are located and the question presents whether the ectopic ureteral orifice corresponds to a simple or to one half of a double kidney on the opposite side. If there are two orifices on one side of the bladder and none on the other one should always keep in mind the possibility of the existence of two ectopically ending ureters of a double kidney on the other side.

(e) *Two Orifices on One Side and Only One on the Other Side of the Bladder* This means a double kidney on one side. The ectopically ending ureter unquestionably corresponds to one half of a double kidney on the opposite side.

c. EXCRETORY (DESCENDING) AND RETROGRADE (ASCENDING) UROGRAPHY

In the chapter on double kidney attention will be drawn to the fact that when a pelvis with only a single (superior or inferior) calyx is found by either or both of the above mentioned diagnostic methods one should suspect the presence of a double kidney.

The interpretation of the urograms (excretory or retrograde) as to whether the ectopically ending ureters and the corresponding "simple" or double kidneys

are normal or pathological, does not differ in any manner from that observed in other urological affections. In general, retrograde (ascending) urography has up to the present time given better pictures in cases of ectopically ending ureters.

A catheter should be inserted as high up as possible through the ectopic ureteral orifice. Instead of using, as formerly, a 12.5 per cent sodium iodide solution, the same opaque mediums are to be recommended as are now employed for intravenous urography, but in 20 per cent strength to outline the course of the ectopically ending ureter and its corresponding renal pelvis. Not only does a deeper shadow result in retrograde injection of the ureter and renal pelvis, but the solution is far less irritating.

In looking over the various reports of operations for ectopically ending ureters, one has the impression that the ideal method of treatment, if this is feasible, would be to reimplant (by the abdominal route) the ureter into the bladder. In the case of unilateral or bilateral ectopically ending ureters which arise

FIG 355

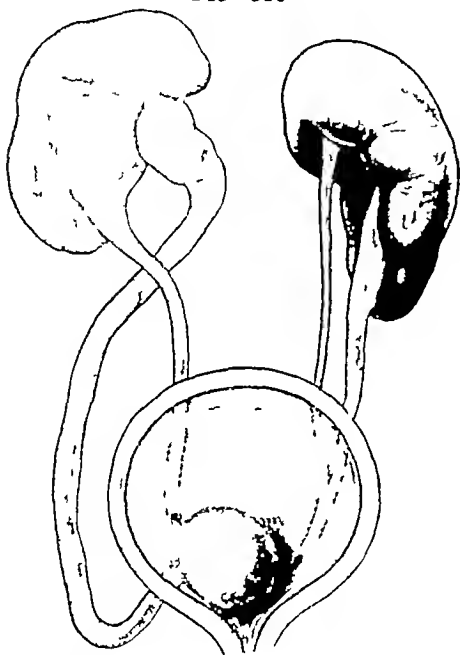


FIG 356

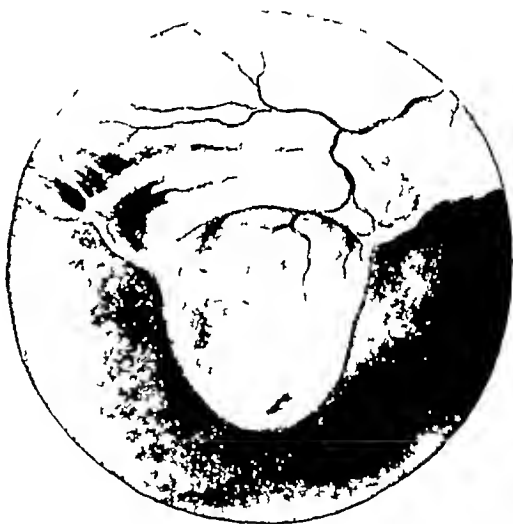


FIG 355—Bostroem's case where one of the ureters of a double kidney ended in a ureterocele which blocked the vesical outlet

FIG 356—Cystoscopic appearance of ureterocele (Baetzner)

from one half of a double kidney, nephrectomy or heminephrectomy respectively are the operations of choice. If there are two ureters, ending ectopically and corresponding to the two halves of a double kidney, only complete nephrectomy will relieve the condition, unless reimplantation of one or both into the bladder is possible.

4 Ureterocele (Cystic Dilatation of the Lower End of the Ureter)

By this is meant a herniation of all of the layers of the ureteral wall into the bladder lumen. The etiology is still the subject of discussion. Some believe that the principal factor is a stenosis or at times, a complete occlusion of the ureteral orifice. Others hold that there is also an absence of the normal mode of attachment between the wall of the ureter and that of the bladder. Under normal conditions, they are separated by a connective tissue layer, known as Waldeyer's sheath. When this is poorly developed, it is not difficult to visualize how a nar-

rowed or occluded vesical orifice of the ureter would result in such a degree of pressure from the reno-ureteral side, as to herniate a loosely attached lower portion of the ureter. The wall of such a ureterocele always reveals microscopically muscle fibers which are continuous with those of the ureteral wall. The surface is covered by the epithelial lining of the bladder. At times one can see a minute ureteral orifice near the apex of the protrusion (Fig 356). The latter varies greatly in size from that of a hazel nut to one filling the entire bladder lumen. The size which such a ureterocele may attain is of much clinical interest.

Clinical Pictures

1 The protrusion may occlude the ureteral orifice of the opposite kidney

2 The protrusion may occlude the neck of the bladder (Fig 355) in such a manner as to give rise to chronic retention of urine as in one of our cases

3 The protrusion may prolapse through the external urinary meatus (Fig 357) and become gangrenous if the condition is not recognized. This has resulted fatally in several reported cases.

FIG. 357



FIG. 358



FIG. 357.—Prolapse of a ureterocele through external meatus of female child. (Gelpel and Wollenberg's case.)

FIG. 358.—Visualization of a right ureterocele with the air of excretory urography and insufflation of air into the bladder. Case reported by Prof. E. Mingazzini of Rome in *Zeit. Urol. Chir.* 1936, 41, 163. Note how well the ureterocele is outlined by the clear zone due to introduction of air into the bladder. (Courtesy of Prof. E. Mingazzini.)

Aside from the clinical pictures which the above present the condition presents no symptoms by which one could suspect its presence. The diagnosis is as a rule made upon cystoscopic examination. One sees a translucent, ovoid or round protrusion in the vicinity of the ureteral orifice on one (Fig 356) or both sides of the bladder.

The possibility of the ureterocele involving one (Fig 359) or both ureteral orifices (Rendus case) of a double kidney must be constantly borne in mind. The cystoscopic appearance of a ureterocele is well shown in Fig 356. Not uncommonly one can observe the intermittent efflux of urine from the minute

orifice at or near the apex of the protrusion. The ureterocele often varies in size while under inspection according to whether it is filled with urine or not. Its

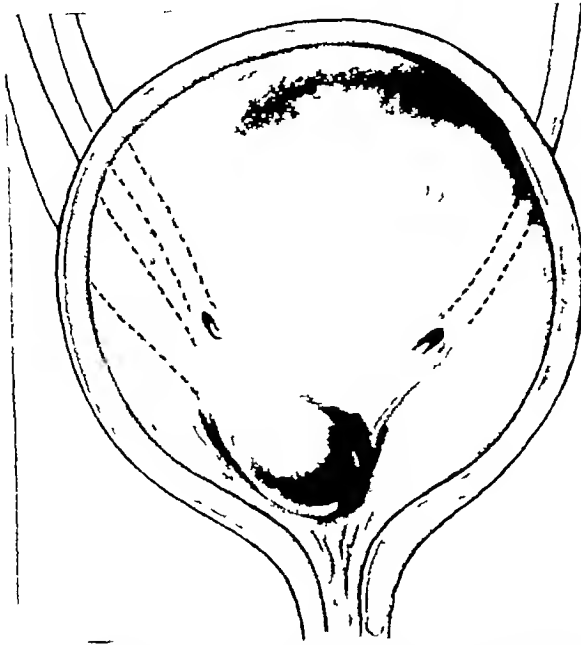


FIG 359—Appearance of opened bladder showing ureterocele of the lower half of a double kidney. Note minute ureteral orifice close to internal meatus (Tilp)

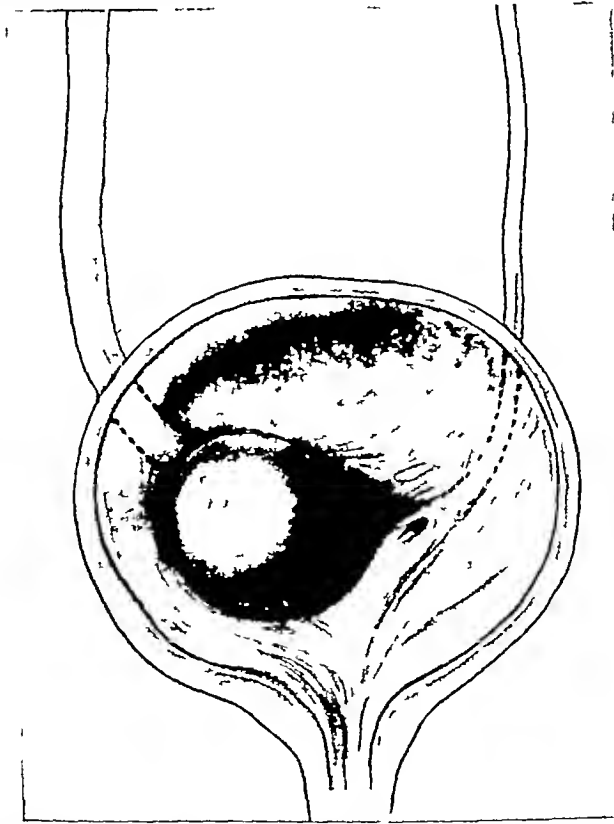


FIG 360—Ureterocele of a single (right) kidney (compare with Fig 359 where ureterocele involved one of the two ureters of a double kidney) Bostroem's case

surface is covered by smooth mucosa with well marked vessels (Fig 356). It must be differentiated from a prolapse of the epithelial lining of the ureter as seen in

cases of calculi impacted at the vesical orifice. The picture of an acute edematous mucosa presenting an appearance like that of an open flower with a depressed center, is quite different from that of a ureterocele. Not infrequently some of the other ureteral anomalies previously described are associated with a ureterocele e.g. stricture, torsion etc.

THE TREATMENT should always be conservative and consists in repeated fulguration through the entire thickness of the wall of the protrusion. The sac will collapse rapidly after the new orifice is made. If this is unsuccessful the bladder must be opened suprapubically and after excision of the protrusion the cut edges of the bladder and ureteral walls approximated.

CHAPTER 30

INJURIES, STRICTURES AND INFECTIONS OF THE URETER

INJURIES OF THE URETER	DEFINITION
A NONPENETRATING OR PENETRATING FORCE	CLASSIFICATION ACCORDING TO ETIOLOGY
GYNECOLOGIC OPERATIONS	INCIDENCE, LOCATION, AGE AND SEX
PENETRATION OF THE URETER BY INSTRUMENTS	CLINICAL PICTURES
STRICTURE OF THE URETER	DIAGNOSIS
PRELIMINARY CONSIDERATIONS	TREATMENT
NORMAL LEVELS OF NARROWING	INFECTION OF THE URETER
MUSCLE SPASM	

INJURIES OF THE URETER

These occur as the result of

- 1 Those due to action of a force having its origin outside of the body, i.e., by external force
- 2 Gynecologic operations
- 3 During urologic diagnostic or therapeutic procedures

A NONPENETRATING OR PENETRATING FORCE

1 Those Due to a Nonpenetrating Force

These are the result of a fall, a kick or a crushing force acting over the lower thorax. In the majority of cases, the ureteral injury accompanies an extensive one of the kidney (see Chapter 33). It is comparatively rare for such an injury to be confined to either the renal pelvis or the ureter. The upper (abdominal) portion of the ureter is most commonly involved, especially the ureteropelvic junction. The symptoms so closely resemble, at the time of the accident, those of injuries of the kidney as to be indistinguishable from them. Later, even though the ureter be only slightly injured, the organization of the peri-ureteral hematoma may compress the ureter to such an extent as to result in stricture formation and hydronephrosis.

THE DIAGNOSIS AT THE TIME OF INJURY by excretory urography will be discussed in connection with injury of the kidney (Chap 33).

THE DIAGNOSIS OF THE SEQUELS of ureteral injury by the action of a nonpenetrating force has been greatly simplified by the use of excretory urography, but as pointed out in enumerating the pitfalls of this method (Chapter 7), there may be so little functioning kidney tissue remaining, that visualization of an accompanying hydronephrosis is impossible, and it is necessary to employ retrograde (ascending) urography as shown in a case reported by one of us.

THE TREATMENT of ureteral injury due to a nonpenetrating force immediately after the accident does not differ from that of the same type of injury of the kidney (see Chap 33). As to the treatment of the sequels, one must be guided by the degree of stricture formation in the ureter and its effect on the kidney. If there is an accompanying advanced stage of hydronephrosis or recurrent hematuria, only nephrectomy can be done, inasmuch as plastic operations in the presence of the marked fixation of the ureter do not appear very promising. The same is true of resection of the strictured area.

2 Those Due to a Penetrating Force

These may be due to penetration of the ureter by bullets, shell fragments, bayonets or other cutting weapons. An unusual case was reported by Dolan (discussion of paper by W E Stevens Jour Urol 1934 31 741) in which both ureters were completely divided in their pelvic portion by a piece of glass incident to an automobile accident. In general injury of the ureter by a penetrating force having its origin outside of the body is comparatively rare. There is a record of only four cases during the World War.

In a case observed by one of us urine escaped from the wound of entrance of a bullet, four days after multiple perforations of the intestine had been sutured. The fistula healed spontaneously, no urine escaping after the sixteenth day. Urography was not done later to ascertain if a stricture developed. In a case reported by Hawley (Am. Jour Surg 1935 27 513) excretory urography revealed a pyelectasis on the sixteenth day after a gunshot wound which also involved the intestines. Later examination showed a stricture at the level where the ureter had been injured.

INJURIES AS COMPLICATIONS OF GYNECOLOGIC OPERATIONS

These can occur during the operation itself or be a late sequel as the result of scar formation. The former is the more frequent and may involve only one ureter or both. The entire cross section of the ureter may be divided by a scalpel or crushed while clamping a vessel, most often the uterine where it crosses the ureter (Fig 38) or the ureter is included in a ligature of the vessel. The injury may not include the entire cross section of the ureter, i.e. it may be partial so that only a portion of the lumen is occluded or there may be simply an injury of the wall termed a parietal injury. To illustrate this latter type a part of the circumference of the ureter may be crushed by an artery forceps or included in a ligature with the result that if necrosis of the wall takes place there is escape of urine through the opening.

Unilateral Injury of the Ureter

EARLY SYMPTOMS OF UNILATERAL INJURY Many cases of injury of only one ureter do not present any immediate postoperative symptoms. It is only when symptoms of stricture or of hydronephrosis are found that the traumatic etiology is thought of. In other cases one or two sequels of the ureteral injury gives rise to symptoms. If the site of injury communicates with the general peritoneal cavity, the clinical picture depends upon whether or not the urine is infected. If it is a generalized peritonitis follows with all of its classical symptoms. If the urine is not infected a so-called urinary ascites follows. Hunner (Jour Urol 1932 28 333) reported two and one of us has observed three others. The peritoneum seems to have a remarkable tolerance for the presence of urine as can often be seen in cases of intraperitoneal injury of the bladder.

If the level of injury does not communicate with the peritoneal cavity the most frequent sequel is the escape of urine from the vagina, i.e. a fistulous communication has formed between the vagina and ureter.

LATE SYMPTOMS OF UNILATERAL INJURY In the majority of cases the fistula will heal spontaneously but as Stoeckel has aptly remarked this is a symptomatic but not a functional success. In the incomplete variety of ureterovaginal fistula (Fig 361) there is a communication with both the bladder and the vagina.

The prognosis is better so far as stricture formation and hydronephrosis is concerned in this type than in the other or complete ureterovaginal fistula (Fig 361) Here obliteration of the ureter and resultant hydronephrosis is almost inevitable

The diagnosis of the level of a unilateral ureteral operative injury and its effects on the upper urinary tract can only be made by ureteral catheterization, i.e. where the obstruction is encountered aided by excretory urography to determine the degree of ureterectasis and pyelectasis

Symptoms of Bilateral Injury

The outstanding clinical feature of these cases is anuria, hence following a major operation of the types previously mentioned, it is imperative to catheterize a patient who has not urinated during the first twelve hours If the bladder is found empty, a cystoscopy and ureteral catheterization must be immediately done If the ligature which occludes the ureters has been loosely tied, there is a slight chance that by manipulation, the ureteral catheters can be passed beyond the point of obstruction If this occurs, the catheters are left in situ to see if any urine escapes, but if not, a flat film is exposed with the catheters still in the ureter If an impassable obstruction is encountered on both sides, the

FIG 362



FIG 361

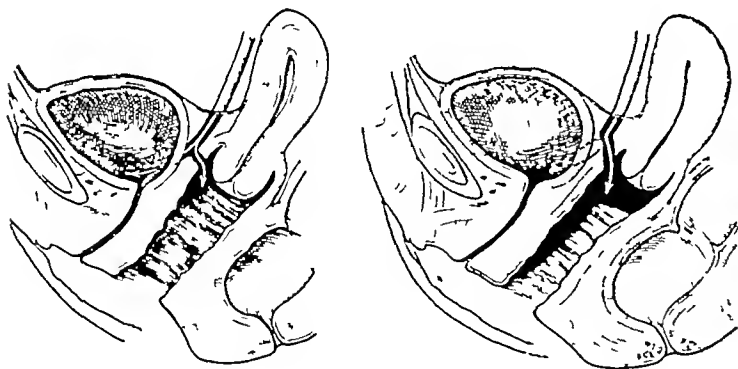


FIG 361—Ureterovaginal fistulae The illustration on left represents the incomplete variety Part of the urine escapes into the bladder and some into the vagina In the illustration on the right is shown a complete ureterovaginal fistula None of the urine enters the bladder, all escaping into the vagina Patient was seen when all of the urine was escaping into vagina from bilateral ureterovaginal fistulae One side healed after use of intying catheter (see text) Nephrectomy was later performed on the other side

FIG 362—Ureteropyelogram from case of ureterovaginal fistula and ureteral stricture, following hysterectomy (see text) Note marked dilatation of the ureter above the point of constriction opposite left, sacroiliac joint Nephrectomy unavoidable because of pyelonephritis

flat film yields information as to the level of the occlusion if the wound is to be reopened, as will be mentioned under treatment

Treatment of Operative Injury of the Ureters

AS A PROPHYLACTIC MEASURE against injury of the ureters, the insertion of ureteral catheters before operation is routinely done by some gynecologists

Immediate repair should be done in the form of uretero-ureteral anastomosis or reimplantation into the bladder, i.e., ureterovesical anastomosis if during an

operation it should be discovered that the ureter has been clamped divided or included in a ligature. The best and simplest method according to Sisk (*Surg. Gynec. and Obst.* 1935 60 857) is end-to-end anastomosis over a ureteral catheter used as a splint. A cut ureter should never be ligated unless the patient is in bad condition (*Newell Am. Jour. Obst. and Gyn.* 1933 25 220) because if the urine is infected, serious postoperative complications will result. In spite of this some gynecologists simply ligate a cut ureter hoping that the urine is not infected.

In the majority of cases injury to the ureter is unilateral but in a certain number both ureters are involved.

If a patient does not void within twelve hours after operation she should be catheterized. If no urine is found in the bladder cystoscopy and ureteral catheterization must be done immediately. If the ligature including the ureters has only been loosely tied there is a slight chance that the catheter can be manipulated so as to be inserted beyond the level of occlusion on each side.

If this manipulation has been successful the catheters are left in situ to see if urine escapes. If not a plain film exposure is made with the catheters in the ureters.

If it is impossible to pass beyond the obstructions the abdominal incision should be reopened within the first 24-48 hours. If the condition of the patient permits.

The urologist co-operates during the operation by passing ureteral catheters and manipulating them so that the gynecologist can repair the ureter or remove the ligatures (deligation) which includes one or both of the ureters.

If the patient's condition does not permit reopening the laparotomy incision or nothing has been done for the first five or six days hoping that a ureterovaginal fistula would develop only nephrostomy is indicated as a lifesaving measure otherwise death from uremia after a variable period of anuria occurs.

As to the late treatment of ureteral injuries incident to gynecologic operations, vaginal operations to close a ureterovaginal fistula are very unsatisfactory. Late operations such as end-to-end or vesico-ureteral anastomosis are seldom successful because of the mass of cicatricial tissue around the level of ureteral injury. Usually only nephrectomy can be done for the resultant (Fig 362) hydronephrosis and hydronephrosis.

PENETRATION OF THE URETER BY INSTRUMENTS

Cases belonging in this group of ureteral injuries have been reported by Noble, Hunner, Young, Sargent, Geisinger, Henline and Burford. They followed various methods employed in diagnosis or treatment of affections of the upper tract such as simple ureteral catheterization without or with the aid of a wire stylet in the lumen of the catheter, dilatation of the ureter or manipulation with special instruments for the nonoperative delivery of ureteral calculi and undue pressure in the injection of opaque media in urography.

There are two types of injury according to Henline (*Jour. Amer. Med. Assn.* 1934 102 182). In one type the less common the instrument perforates (Fig 363) the ureter while in the other the more frequent the ureter is ruptured in its longitudinal axis. These accidents are more likely to occur when some pathological change exists than in the normal ureter.

STRICTURE OF THE URETER

PRELIMINARY CONSIDERATIONS

In order to evaluate the results of a urologic examination of a suspected ureteral stricture, certain factors which can lead to an erroneous diagnosis must be constantly kept in mind. These are

- 1 That narrowings are present at certain levels in the normal ureter
- 2 That spasmodic contraction of the circular muscle of the ureter has been observed in the normal human and animal ureter

These observations have been confirmed clinically by Braasch, and others, and regarded as a manifestation of a pathologic physiology of the ureter

1 Normal Levels of Narrowing

A table showing the levels of the most common normal narrowings and the caliber of bougie or catheter which can pass through, is shown on page 33

2 Muscle Spasm

This has been shown clinically to result in an apparent narrowing or filling defect which will be seen at one examination and be absent at another

Keeping these two sources of error in mind, we can now attempt to define a stricture of the ureter

DEFINITION

A ureteral stricture is a narrowing of the lumen, due most commonly to inflammatory changes in its wall

Such a narrowing must be found at the same level (distance in centimeters from the ureteral orifice) at every examination¹ and urograms must reveal a ureterectasis above the stricture level in films¹ exposed in series at the same sitting or in every film at subsequent sittings

CLASSIFICATION ACCORDING TO ETIOLOGY

All ureteral strictures may be placed into two principal groups: 1 Those of congenital and 2 Those of acquired origin. The former are found clinically as a rule in infancy and childhood, yet at times, cases are encountered in adolescents and adults, in which it is difficult if not impossible to determine whether they represent the persistence of a congenital anomaly or are the result of a postnatal infection

Congenital Strictures

These have been discussed in the chapter on Anomalies of the Ureter, and their clinical aspects in infancy and childhood will be taken up in the chapter on urological affections in that period of life

Acquired Strictures

- 1 Of inflammatory origin (nontuberculous and tuberculous)
- 2 Following decubital ulceration (Fig 364) due to ureteral calculi
- 3 Due to neoplasms, etc. including those incidental to irradiation
- 4 As a sequel of injury

1 STRICTURES OF INFLAMMATORY ORIGIN (nontuberculous and tuberculous) In this subgroup, the infection may have its primary localization in the wall of the

¹ It is self-evident that these requirements only apply to cases which have not been treated by dilatation, etc

As a rule, there is ureterectasis proximal to the area of stricture formation. The degree of ureterectasis is in direct proportion to the degree of obstruction offered to the urinary current by the strictured area.

With the exception of the specific histologic changes, incident to tuberculous infection, the fibrosis in cases with this etiology does not differ from that due to nontuberculous infection.

2 STRICTURES DUE TO DECUBITAL ULCERATION FROM IMPACTED URETERAL CALCULI (Fig 364) Stricture formation is not uncommon in cases where a ureteral calculus has been impacted for a long time. It was formerly believed that this was most likely to take place in the juxtavesical (Fig 364) portion of the ureter. A sufficiently large number of reports of cases of spontaneous perforation of the ureter in its upper portion have appeared to show that decubital ulceration from ureteral calculi can occur at any level and be followed by later stricture formation.

3 THOSE DUE TO NEOPLASMS (Fig 391) AND IRRADIATION Narrowing of the ureteral lumen incident to neoplasms arising in the ureteral wall or compressing the ureter from without will be taken up in the next chapter. They must, however, always be kept in mind in the examination of a case of stricture of apparently inflammatory origin.

The present extensive employment of irradiation for cancer of the uterus, has been followed by the report of ureteral stricture formation incident to the use of radium. Bugbee (*Jour Urol* 1934, 32, 439) could find no reference to any reports of such a sequel up to the time his paper was published. He had observed a unilateral obstruction in seven cases and a bilateral in one case, all of which had been treated with radium for carcinoma of the cervix. In the first six cases, nephrectomy for pyonephrosis was necessary within intervals varying from five months to nine years following irradiation. The most common location was 4 cm above the ureteral orifice.

In this subgroup of compression of the ureter by extrinsic pathological conditions must also be included cases in which the ureter is occluded to a variable extent by calcified lymph nodes. Reports have appeared in which such an occlusion without demonstrable changes in the ureteral wall itself had given rise to a syndrome resembling in every detail that of ureteral stricture or calculus.

4 AS A SEQUEL OF INJURY This has been discussed in the first portion of this chapter, under injuries of the ureter.

INCIDENCE, LOCATION, AGE AND SEX

As to the question of incidence, we are chiefly interested in this portion of the chapter in strictures of nontuberculous inflammatory origin.

Necropsy Incidence Our knowledge of their incidence is partly based on necropsy, partly on clinical observations. As to the former, Schreiber (*Surg Gynec and Obst* 1927, 45, 423) claimed to have found "a stenosis in ten and an irregular dilatation secondary to a postinflammatory scarring in two" in 100 consecutive necropsies. There was a narrowing at the level of union of the two ureters in a case of double kidney, a frequent finding, without being interpretable as a stricture in such an anomaly (Fig 431). In seven other cases, the ureteral condition was the result of extension of infection from adjacent structures. This leaves only four of the 100 necropsies in which stricture formation, apparently primary in the ureter, can be accepted as such.

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Frater and Braasch (Surg Gynec. and Obst 1929, 48 390) examined the ureters in 93 consecutive necropsies and only found two strictures, one secondary to a carcinoma of an adjacent viscus and the other of congenital origin. No inflammatory strictures were found.

Carson in 300 necropsies found strictures of inflammatory origin in 8 and congenital strictures in 3.

AS TO THE CLINICAL INCIDENCE of stricture formation there is still much difference of opinion. Hunner's claim that they are very common in women has

FIG. 365



FIG. 366



FIG. 365—Urogram from case of stricture at junction of iliac and pelvic portions of ureter in renal tuberculosis. Note enormous dilatation of ureter immediately above stricture.

FIG. 366—Urogram from case of bilateral strictures at different levels in woman of forty. Symptoms those of chronic cystitis.

been receiving less and less endorsement from urologists in the United States and Europe. Much credit is due to Hunner for having drawn our attention to the more frequent existence of ureteral stricture than had been generally believed prior to the publication of his articles. To assume a nihilistic attitude and say that they do not exist at all is to close our eyes to something that every impartial observer knows does exist but in only a small fraction of the large number of cases claimed by Hunner and those who share his opinion. The rigid requirements to be fulfilled before a diagnosis of ureteral stricture is made at the present time have placed the entire question on a more exact basis.

Location. The most frequent location of strictures of inflammatory origin is in the first six centimeters above the ureteral orifice (Figs. 365, 367 and 368) and next most frequently at the ureteropelvic junction. These are the levels at which the majority of normal narrowings are found. Less common are the strictures

of inflammatory origin in the portion of the ureter between these two levels. As a rule, only one level is involved, although multiple strictures (Fig 366) in the same ureter occur from time to time. The stricture may be confined to one or it may be found in both ureters.

Age and Sex As to sex, the incidence is higher in women than in men. As to age, if one excludes congenital strictures, the majority of which are seen clinically in infants and young children, no decade appears to predominate.

CLINICAL PICTURES

Many cases are latent, i.e. present no symptoms, as evidenced by some of the clinical histories of the patients whose ureters were studied at necropsy by Schreiber. Aside from these latent cases, there are others with definite symptoms, none of which however are pathognomonic for ureteral stricture, i.e. they are found in many other affections of the upper urinary tract. Clinically, one encounters patients whose chief complaint is one of the following:

- 1 Pain alone, periodic or recurrent, and referred to the kidney or along the course of the ureter.

- 2 Symptoms of upper urinary tract infection, with or without the history of the passage of small calculi.

- 3 Recurrent Attacks of Hematuria Alone

Every possible combination of these three may be found. Crabtree and Kontoff (*Jour Urol* 1933, 32, 421) in an analysis of 40 personal cases found associated pain and infection in 8, pain and hematuria in 5 and infection and hematuria in 2.

DIAGNOSIS

This is based (a) on the data obtained from a carefully taken clinical history, with especial attention to early symptoms and (b) the results of the urological examination. Abdominal palpation is of little value in these cases, but this is not true of examination of the genital tract in both sexes.

Extension of infection from the parametria as well as from the seminal vesicle and prostate to the adjacent portions of the ureter has been referred to above.

Bougies The urological examination should always include the passage of bulbous bougies as well as excretory and retrograde urography. Some urologists prefer the Braasch bougie (Fig 369), others the Garceau or Blasucci (Fig 369). These are passed beyond the strictured area and then slowly withdrawn until a resistance or "hang" is encountered.

Less and less reliance is being placed upon the results of this method of examination. It is only of value if the "hang" is found at the same level at successive examinations and this evidence corroborated by positive urographic findings.

URETERAL SPASM One must never forget that a localized ureteral spasm (Fig 367) can exist just as Keyser has pointed out (*Jour Urol* 1928, 19, 355). Some psychoneurotic individuals have cardiospasm or pylorospasm. Such a "nodal spasm" (Keyser) gives rise to the same resistance or "hang" in withdrawing a diagnostic bougie as does a true stricture and is impossible to differentiate from the latter if one depends on this test alone.

Urography At the present time urography is regarded as the most reliable method of diagnosis. Here again the results of a single examination are not sufficient evidence upon which a diagnosis of ureteral stricture can be made.

FIG. 367



FIG. 367—Stricture in pelvic portion of the left ureter at level of filling defect just below pelvic brim. Note marked proximal ureterectasis and pyelectasis also filling defect due to ureteral spasm at junction of ureter and renal pelvis.

FIG. 368—Ureteropyelogram in case of stricture in juxtavesical portion of left ureter. Note marked dilatation of ureter and renal pelvis proximal to strictured area indicated by white arrow. Patient was man of fifty.

The appearance of a narrowing in the contour of the ureteral shadow (Figs 367 and 368) with ectasis of the superjacent portion of the ureter on films taken at successive examinations is necessary before a diagnosis of ureteral stricture can be made. A single urography does not suffice.

FIG. 368



RETROGRADE UROGRAPHY Thus far the majority of urologists have continued to employ the retrograde (ascending) method of urography. A 20 per cent solution of Neopax, Neosklodan or Diodrast causes so little reaction when injected slowly and with a minimum of pressure into the ureter that the possible occurrence of ureteral spasm can be left out of consideration. The ureteral catheter should be gradually withdrawn while injecting the opaque medium and before

the first exposure is made so as to obtain an image of the entire length of the ureter

EXCRETORY UROGRAPHY (see Chapter 7 on Radiography) should also be routinely employed, if possible, in all cases of suspected ureteral stricture. As a rule, it is difficult to obtain a good ureteral shadow unless there is a marked decrease in the size of the lumen, imperfect visualization of the ureter being one of the disadvantages of this method in most cases.

TREATMENT

This should include

1 Elimination of Focal Infections²

2 Search for evidences of renal tuberculosis as the point of origin of the infection which has secondarily given rise to the ureteral stricture (See Chapter 41)

3 Treatment of genital conditions any gynecologic condition or disease of the prostate or seminal vesicles from which infection continues to extend to the strictured area in the ureter

4 Dilatation of the Strictured Area If the urological examination fails to reveal the presence of changes in the kidney which call for more radical measures, the dilatation of the stricture associated with lavage of the renal pelvis

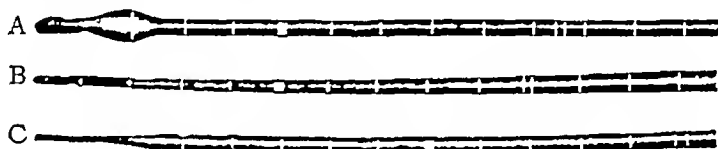


FIG 369—A Whistle tip graduated Braasch bulb Sizes of bulbs 8-10-12-14 Fr
B Whistle tip graduated Garceau Size of tip 5 to 6 tapering to size 9-10 or 11 Fr
C Filiiform tip graduated Blasucci Sizes 5 to 8 Fr (Courtesy O. Carliczek and Co.)

to combat the concomitant infection, is indicated. Some urologists prefer the various bulbous bougies shown in Fig 369 but we have obtained very satisfactory results by using the ordinary ureteral bougies (Fig 82) which are much easier to pass through the McCarthy foroblique cystoscope than the bulbous bougies. If there are bilateral strictures, one should never attempt to employ dilatation on the two sides at the same sitting. In general, it is advisable to advance slowly in the use of ureteral bougies and one should never attempt to use force if any resistance is encountered at the stricture level. The dilatation sittings should, preferably, be at intervals of two weeks and preceded by the administration of some sedative.

5 Surgical Measures These will vary with the individual case. In general, if the lumen of the stricture is very narrow, is very resistant to dilatation and there is evidence (Fig 370) of advanced renal changes (infected or noninfected hydronephrosis), nephrectomy is indicated if the condition of the opposite kidney justifies such a step. Nephrectomy was necessary in 9 of 40 cases reported by Crabtree and Kontoff (loc cit) for one of the following reasons: (a) inability to either pass instruments through the stricture or free it surgically sufficiently to do so, (b) inability to maintain dilatation, and (c) because of the renal pathology.

² These play far less of a role in the etiology of ureteral stricture than was claimed by Hunner.

already present In one of our cases (Fig 368) the functional capacity of the opposite kidney was so decreased that nephrectomy was deemed inadvisable on the side of the ureteral stricture The patient died a few months later of uremia

FIG. 371

INFECTIONS OF THE URETER

These may be localized often resulting in stricture formation as just described or they may be more diffuse In the latter form of ureteritis either the mucosa and submucosa are involved or the infection involves the entire thickness of the wall as well as the periureteral tissue In the diffuse form the infection extends by continuity as a rule from a similar type of pyelonephritis less often by continuity from a cystitis Infections which extend by continuity from a prostatitis seminal vesiculitis or endocervicitis usually are followed by a localized infection of the ureteral wall from without inward and may terminate in stricture formation Tuberculosis of the kidney extends to the

FIG. 370

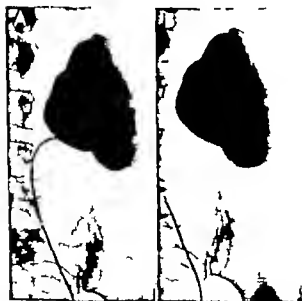


FIG. 370—Pyelograms from case of infected hydronephrosis due to stricture at outlet of renal pelvis and complicated by toxic nephritis of opposite kidney A. Before withdrawal of catheter B After withdrawal of catheter showing complete retention for one hour

FIG. 371—Operative specimen (nephro-ureterectomy) showing multiple cyst formation on epithelial lining of ureter (ureteritis cystica) (Courtesy Dr J B Kirshbaum)

corresponding ureter at a relatively early stage The ureter of the opposite kidney is often involved as the result of an ascending infection by reflux or by



way of the lymphatics from a tuberculous bladder (see Chap 41) In nontuberculous infections, the symptoms of ureteral involvement cannot be distinguished from those of the underlying pyelonephritis or cystitis The following types of pathological changes incident to infection of the urinary tract will be mentioned under ureteritis, because at times, they can be recognized clinically These changes are found not only accompanying infections of the ureter, but in those of the renal pelvis and bladder In the latter, their presence can be recognized at cystoscopy These sequels of nontuberculous infections are

1 **Ureteritis Cystica** This is characterized by the formation of small vesicles on the mucosa (Fig 371) which are the result of liquefaction of a collection of cells, termed cell-nests by von Brunn They do not rise to any characteristic clinical symptoms Kindall (Jour Urol 1933, 29, 645) made a preoperative diagnosis in one case The ureterograms showed (Fig 372) a number of minute round

FIG 372



FIG 373

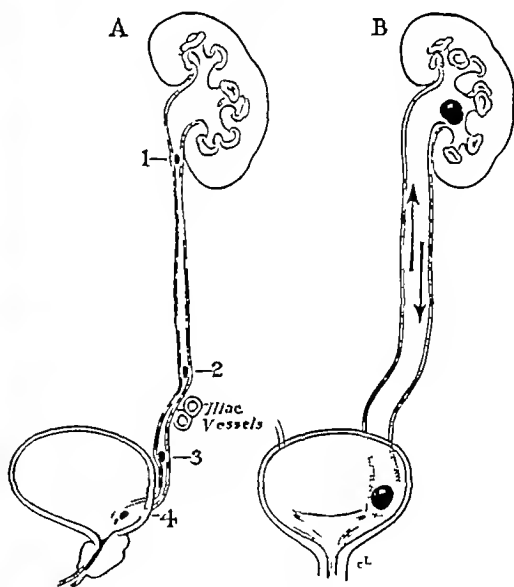


FIG 372—Urogram from case of bilateral ureteritis cystica Note multiple small filling defects (Kindly loaned by Dr Lloyd Kindall)

FIG 373—A Diagrammatic representation of most common levels at which ureteral calculi are impacted 1 Just below uretero-pelvic junction 2 In iliac ureter 3 In juxtavesical portion of ureter 4 Just proximal to vesical orifice

B Diagram to show how a calculus can migrate from the renal pelvis to the lowermost portion of the ureter and vice versa, if the ureter is dilated See also Fig 374

filling defects Fite (Urol and Cut Rev 1935, 35, 91) and Bieberbach (Am J Roent 1934, 31, 778) report similar urographic findings, but in neither of them was the correct preoperative diagnosis made These lesions may give rise to hematuria or favor persistence of infection

2 **Ureteritis Granularis** and 3 **Leukoplakia** The mucosal changes in these two sequels of chronic urinary tract infection are discussed in the chapter on nontuberculous renal infections

4 **Granuloma** These are localized areas of hyperplasia of the mucosa and submucosa the result of inflammation in the urinary tract They vary from minute granular patches in the mucosa to papillomatous proliferations, according

to Braasch and Hurley (Jour Urol 1927, 18 595) They may also cause hematuria and favor persistence of infection as in the case of the other sequels of chronic infection While rarely as generalized as ureteritis cystica they may be scattered over the entire ureter When localized and situated near the ureterovesical junction, the simulation of neoplasm is very close, as in two of the cases reported by Braasch and Hurley

CHAPTER 31

URETERAL CALCULI AND NEOPLASMS

URETERAL CALCULI

GENERAL CONSIDERATIONS
COMPLICATIONS
CLINICAL PICTURES
DIAGNOSIS
TREATMENT

URETERAL NEOPLASMS

ORIGIN
LOCATION, AGE AND INCIDENCE
SYMPTOMS
EXAMINATION
DIAGNOSIS
TREATMENT

URETERAL CALCULI

GENERAL CONSIDERATIONS

Primary and Secondary By the former, is meant a calculus which has formed in the ureter itself as distinguished from a secondary calculus which has its origin in the kidney but is found in the ureter, as the result of peristaltic movements of the renal pelvic musculature in its efforts to expel a foreign body. Although Hunner still maintains that the majority of ureteral calculi are primary, this opinion is only shared by others to the extent that this may be possible in the presence of a stricture or any other type of obstruction, but not when these are absent.

Location This depends upon several factors

- 1 The location of the normal levels of narrowing of the normal ureter (Figs 41 and 346)
- 2 The presence of any pathologic narrowing
- 3 The degree of ureterectasis as the result of infection or of neurogenic dysfunction of the ureteral musculature

1 THE MOST FREQUENT LEVEL at which ureteral calculi are found is in the pelvic (juxtavesical) portion. The caliber of the ureteral lumen at this level varies from 1-5 mm (3-15 F catheter caliber) as shown in Fig 373. The next most frequent level is close to the junction of the ureter and renal pelvis. The smallest number of calculi are found in the iliac ureter, i.e. between the crest of the ilium and level of crossing of the iliac vessels (see Figs 36 and 373).

In a series of 1,584 cases reported by Jeanbrau, Judd, Mathé, Foley, Ravich and Bugbee, the calculi were found in the pelvic and intramural portions of the ureter in 1,248 (about 79 per cent), in the lumbar ureter in 305 and in the iliac ureter in only 31.

2 PATHOLOGIC NARROWINGS of the ureter also play an important part in the incidence of the level at which ureteral calculi are found. If the narrowing precedes the formation of the calculus in the kidney or, exceptionally, in the ureter, the calculi are found just above or at the point of stenosis. If, however, the pathological narrowing is secondary to a decubital ulceration followed by fibrosis of the adjacent ureteral wall, the result of prolonged fixation of a calculus (Fig 364), the latter is found as a rule at that level.

3 URETERECTASIS That calculi are often found at different levels in consecutive examinations must be constantly kept in mind, clinically. This change

of location is often found in association with ureterectasis due to mechanical obstruction (stricture, calculus blood vessels etc.) or to ureterectasis of inflammatory or neurogenic dysfunction (Fig 347) The calculus may be found at different levels (Fig 374) at consecutive radiographies the same day week or month This change in location can occur when the patient is placed in the Trendelenburg position preliminary to a ureterotomy the calculus being displaced into the renal pelvis In all cases in which urography reveals the presence

FIG 374



FIG 375



FIG 374—A. Urogram from case in which a ureteral calculus migrated (see text) from its location in the pelvic portion of the left ureter (indicated by arrow) to the renal pelvis as shown in B and vice versa. This case illustrates the necessity of a plain radiograph immediately before operation when the injection of an opaque medium reveals the presence of a dilated ureter and renal pelvis. A diagram of the conditions in this case is shown in B of Fig 373

FIG 375—A. Case in which there was one fairly large and a number of smaller (not shown in print) left renal and an impacted right ureteral calculus. The latter was removed first, as explained in text.

B. Moderately advanced dilatation of renal calices favoring reformation of calculi (see text of Chapter 42)

of a marked ureterectasis (Fig 374) it is advisable as soon as the ureter is exposed to place a temporary loop or loosely tied catgut ligature above and below the point where the calculi are palpated to prevent their slipping back into the renal pelvis or downward into the juxtavesical ureter

Size Age Sex and Side These aspects of ureteral calculi in so far as they concern infancy and childhood will be discussed in Chapter 46 To adults the size of ureteral calculi varies greatly from that of a kernel of wheat to almost incredibly large dimensions. Schultheis (Zeit Urol 1932 26 480) reported one which was 12 cm long 12 cm in circumference and 100 Gm in weight. Bachrach cites a case of calculus 19 cm. long The majority of ureteral calculi are found between the ages of twenty and fifty and more frequently in males. Both sides are about equally involved.

Ureterolithiasis is as a rule unilateral Of 648 cases at The Mayo Clinic, only eight were bilateral A single calculus was found by Braasch and Moore in

261 cases and multiple in only 17. They also found that ureteral calculi are associated with renal in less than five per cent of the cases. The following associations may occur:

1. Calculi in both kidneys and one ureter
2. Calculus in one kidney and opposite ureter (Fig. 375)
3. Calculi in one kidney and both ureters (Fig. 376)
4. Calculi in both kidneys and both ureters (rarely observed)

Form, Surface and Composition These resemble closely the corresponding physical characteristics of renal calculi. They may be round, ovoid (Fig. 377) or irregular (Fig. 389). The surface is usually smooth or finely granular. It may, however, be quite rough, with a number of projecting spicules so that the calculus is firmly fixed in the folds of the epithelial lining of the ureter, offering much resistance to any effort of manipulative removal.



FIG. 376—Calculi in both ureters (pelvic portion) and also one in right renal pelvis. The left ureteral calculus which was firmly impacted, was removed first in order to avoid a calculous anuria (see text).

COMPLICATIONS

Effects on ureter and periureteral strictures

These depend on (a) whether the calculus is fixed and (b) the presence of a concomitant infection. If the former exists, a variable degree of local inflammatory reaction, both of the ureteral wall and periureteral sheath, takes place. Adhesions to the parietal peritoneum are often so dense that it is difficult to avoid opening the peritoneal cavity during ureterolithotomy, especially in the pelvic portion of the ureter. Such firm adhesions between the iliac vessels and ureter were found by us in several cases, so that access to the pelvic ureter through an iliac incision (see Chap. 53)

was impossible without risking injury to the iliac vessels in exposing the ureter. Another result of such a localized periureteritis secondary to impaction of a calculus, especially in the juxtavesical portion of the ureter, is the conversion of the ureter into a rigid tube, rendering it very difficult to palpate a calculus.

The degree of ureterectasis on the proximal side of the calculus varies with the degree of its fixation. Dourmashkin has shown that the reason there is less ureterectasis in some cases than in others is the existence of furrows or grooves (Fig. 378) on the calculus which permit the urine to find its way toward the bladder. When such channels do not exist, ureterectasis first, then pyelectasis occurs. Both favor infection, ending in destruction of the kidney (see below). The size of a calculus is not always a criterion of the extent of damage to the ureter.

and kidney. A relatively small calculus tightly impacted will do more damage than a larger one which is not fixed and which does not cause back-pressure on the proximal ureter and renal pelvis. In some cases a sudden complete blocking of the ureter will be followed by acute distension above the level of obstruction, and this ureterectasis soon extends to the renal pelvis. In a relatively small number of cases of fixed ureteral calculus, especially in the lumbar ureter the



FIG. 377.—Very large ureteral calculus seen at right in insert and at left as a large shadow over right sacroiliac joint.

calculus perforates the ureteral wall and escapes into the periureteral tissues with resultant abscess formation. A typical case of this kind which was diagnosed before operation was reported by Chevassu (*Jour d'Urol* 1933 36 78).

At times the ureterectasis is out of all proportion to the extent of calculous occlusion. Evidently in these cases the ureterectasis is the direct result of infection or of neurogenic dysfunction (Fig. 347).

Effects on Kidney

This varies both in its pathological changes and clinical pictures (see later) according to whether complete blocking of the ureter takes place suddenly or gradually.

1 EFFECT ON KIDNEY OF "ACUTE URETERAL BLOCK" If the urine is not infected, an acute distension of the ureter takes place above the level of obstruction and, next, of the renal pelvis, resulting in hydro-ureter and hydronephrosis. Unless removal of the obstructing calculus is carried out after too long an interval (2-4 weeks) the ureterectasis and pyelectasis recede and renal function is restored.

If the urine is infected, an acute suppurative pyelonephritis (see Plate XI) follows very rapidly and may end fatally as the result of a septicemia. Here, failure to discover the presence of a ureteral calculus as being the factor directly responsible for the acute renal infection, may not only result in the loss of a kidney but in the death of the patient.

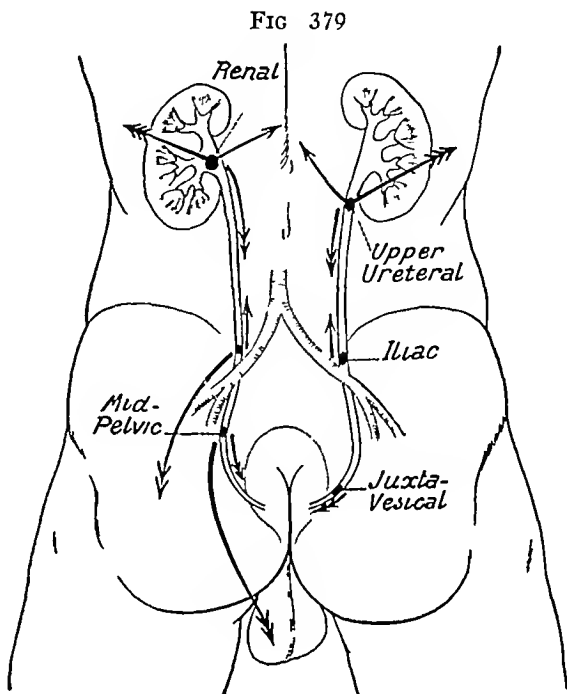
An "acute ureteral block" instead of giving rise to an acute

FIG 378



FIG 378—Grooved ureteral calculus permitting escape of urine alongside the obstruction (Courtesy of Dr R L Dourmashkin)

FIG 379—Posterior view of trunk with diagram to indicate radiation of pain in renal and ureteral calculi. These directions (as indicated by arrows) in which pain radiates holds also for any other cause of renal or ureteral pain. The triple headed arrows indicate most common, the less common, and single headed arrows, the least frequent radiation of pain.



pyelonephritis may be followed by inhibition of the secretory activity of the corresponding kidney. If the blocked ureter is that of a congenital solitary kidney (Figs 180 and 393) or that of a "remaining" kidney (following removal of the opposite organ), anuria results. If there are two kidneys, anuria may follow acute ureteral block on one side through reflex inhibition of the secretory activity of the opposite kidney or through inability of the latter because of its lack of development (congenital hypoplasia as in Fig 396) to do the work of both, when called upon to do so, suddenly.

2 EFFECT ON KIDNEY OF "CHRONIC URETERAL BLOCK" The degree of ureterectasis, pyelectasis and involvement of the renal parenchyma depends upon the degree of occlusion of the ureter and the virulence of an associated infection. In general, the latter plays a more important part in the destruction of the kidney than the degree of obstruction. The effects on the kidney, when back-pressure plus infection of long duration are due to ureterolithiasis, do not differ from those observed in nephrolithiasis and will be discussed in Chapter 42.

CLINICAL PICTURES

In sudden complete occlusion of the ureter by a calculus, the clinical pictures differ considerably from those seen in cases of gradual complete or incomplete occlusion. We will employ the terms acute ureteral block and chronic ureteral block because they will aid in remembering the respective predominant symptoms.

Clinical Pictures in Acute Ureteral Block

GROUP 1 COLICKY OR FIXED PAIN IN THE COLICKY TYPE the pain is very severe and radiates downward along the ureter into the testis or into the labia less often toward the gluteal region or inner aspects of the thighs (Fig. 379). Radiation downward occurs less frequently in high lying calculi than in those located in the lower ureter.

IN CASES OF FIXED PAIN it may be equally severe and varies in location according to that of the calculus. These fixed pain cases are often erroneously diagnosed as acute appendicitis when the pain is referred to the right lower quadrant.

FIG. 380

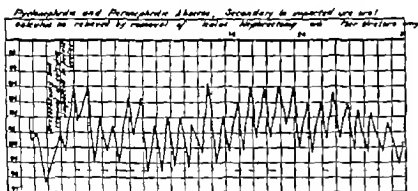
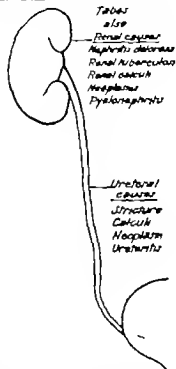


FIG. 380—Chart from case of firmly impacted left ureteral calculus. It was thought that the ureterotomy would be followed by better drainage for the severely infected kidney. The septic symptoms, including fever, continued, however, and at a secondary operation a large perinephritic abscess was found as the source of the persistent urosepsis in addition to an advanced pyelonephritis necessitating nephrectomy.

FIG. 381—Diagram to show various conditions which can give rise to typical ureteric colic Syndrome.

FIG. 381
Causes of Renourteral Colic



IN BOTH COLICKY AND FIXED TYPES. In both the colicky and fixed types of acute pain the sudden rise in intrapelvic (renal) pressure acting upon the nerves of the kidney is responsible for the pain.

Both the colicky and fixed types may be accompanied by symptoms of a reflex character such as nausea, vomiting, inability to pass flatus, abdominal distension, sweating, and rise in pulse rate. At times the reflex paresis of the intestinal musculature results in such a degree of abdominal distension as to simulate an acute ileus. Israel, who was one of the first to describe such cases, termed it renal ileus. We have had occasion to see a patient with a calculus in the pelvic ureter who had been laparotomized under this diagnosis.

We will call attention under treatment to the immediate relief which the

passage of a ureteral catheter gives, when passed beyond the obstruction, in this first group of acute ureteral block

GROUP 2 ACUTE PYELONEPHRITIS SYMPTOMS PREDOMINATE Here, the clinical picture is that of a very severe acute renal infection. The fever may be of the continuous or remittent type (Fig 380) accompanied by a rapid pulse, a moderate leucocytosis, marked tenderness over the kidney and rigidity of the muscles of the abdominal wall, especially over the iliocostal space.

In some cases, cycles of chills, fever and sweats recur at irregular intervals. The signs of a generalized toxinemía, such as stupor, dry tongue, increasingly rapid and weak pulse, etc., soon supervene unless relief is given by ureteral catheterization or operation for removal of the calculus.

In fulminant infection due to an acute ureteral block, there may be a history of acute pain preceding the symptoms of acute pyelonephritis, but there are other cases in which there is an absence of any localizing symptoms pointing to the ureteral obstruction as the cause of the clinical picture of severe acute renal infection.

GROUP 3 ANURIA Anuria is the first indication of acute ureteral block. As in the preceding group, cases are encountered in which a typical syndrome of pain (Group 1) has preceded the onset of the anuria. There are others, however, in which such a colicky or fixed pain history cannot be elicited. As we will point out under treatment, every case of anuria, whether preceded by pain or not, should be given the benefit of ureteral catheterization even if plain radiography and excretory urography are negative.

Clinical Pictures in Chronic Ureteral Block

Only the outstanding symptoms in each group will be mentioned, because they greatly resemble those seen in nephrolithiasis (Chapter 42).

GROUP 1 HISTORY OF ONE OR MORE ATTACKS OF TYPICAL RADIATING OR OF FIXED PAIN The latter may persist as the principal complaint.

GROUP 2 HISTORY OF ONE OR MORE ATTACKS OF ANURIA, preceded, or not, by pain as in Group 1.

GROUP 3 HISTORY OF ONE OR MORE ATTACKS OF SYMPTOMLESS HEMATURIA alone or accompanied by colicky or fixed pain.

GROUP 4 PERSISTENT PYURIA with or without a history of preceding attacks of pain, anuria or hematuria or any combination of these three.

GROUP 5 MASS IN KIDNEY REGION due to a hydronephrosis or a pyonephrosis which may or may not be preceded or accompanied by any single or combination of the symptoms of the four preceding groups.

GROUP 6 LATENT, I E, SILENT CASES in which ureteral calculi are found during an examination for other abdominal or urological conditions.

DIAGNOSIS

This is based on the following data:

A A carefully taken clinical history

B The results of the urologic examination

A The Value of the Clinical History

This includes questions as to whether there is a history of a preceding "acute ureteral block," as outlined above or of any symptoms indicating a "chronic ure-

teral block. Under the latter heading special attention should be given to finding out if a dull, persistent pain exists at a fixed point along the course of the ureter.

PAIN It is of interest to note as to the history of colics, that Ravich (Jour Urol. 1933, 29 171) found that in 758 cases of ureteral calculi there was no history of colic in 78, a first attack of pain in 157, two attacks in 141 and that 382 had a number of attacks.

Not only during the course of an 'acute ureteral block' of the colicky pain type but also in the general examination of a patient at a subsequent period it is necessary to keep in mind that there are a number of other renal and extrarenal conditions which can simulate in every respect the pain syndrome (renal colic as it is usually termed) of an acute ureteral block. These will only be enumerated.

1 THOSE OF THE URINARY TRACT (SEE FIG 381)

Ditt's crises due to kinking of the ureter in cases of movable kidney (Fig 135)

Thrombosis or embolism of the renal vessels (Plate V)

Chronic nephritis (Chapter 44)

Passage of clots, uric acid or oxalate of calcium crystals in so-called showers.

Ureteral stricture

2 THOSE OF THE CENTRAL NERVOUS SYSTEM

Renal crises in tabes

3 THOSE OF INTRAPERITONEAL VISCERA

Acute appendicitis

Gallstone colic, especially in cases of low lying gallbladder

Ileus.

B The Results of the Urologic Examination. This must include examination of the central nervous system for tabes search by bimanual palpation for an enlarged kidney (hydro- or pyonephrosis) microscopic and bacteriologic examination of the urine cystoscopy ureteral catheterization and the various radiographic procedures mentioned in Chapter 7 for examination of the upper urinary tract. We will only discuss the three last named.

EXAMINATION OF THE URINE In the majority of cases about 90 per cent the gross and microscopic examination of the urine shows the presence of leucocytes in larger than the normal (5-7) number and red blood cells in variable amount. Dourmashkin found red blood cells microscopically in 92 per cent of 355 cases. Bumpus and Thompson report that in 300 of 1001 cases gross hematuria had been observed by patients but that in only 57 of 1001 cases was blood found on microscopic examination. When the calculus was located in the right ureter a relatively large number have been operated for appendicitis because of the resemblance of the symptoms hence plain radiography and if necessary excretory urography should be routinely carried out if there is any question as to diagnosis. The difficult cases in this category are those in which a hematuria accompanies an appendicitis and plain radiography is negative for ureteral calculus. As a rule the pain in acute block due to renal or ureteral calculus has definite radiations as mentioned under diagnosis whereas after the first few hours the pain in appendicitis is well localized over McBurney's point (middle of a line from umbilicus to anterior superior spine of ilium) and is accompanied

been proposed to visualize such nonopaque calculi Kummel and others have called attention to the presence of less opaque areas, corresponding to the location of nonopaque calculi, in ascending (retrograde) urograms This method is very useful, at times, in both ureteral and renal (see Chapter 42) nonopaque calculi It was hoped that excretory urography would render nonopaque calculi more visible, but this has not proven to be the case

EXCRETORY UROGRAPHY IS, however, of definite value in acute ureteral block cases It yields information as to the presence and ability to function, of the opposite kidney and whether the kidney on the blocked side fails to eliminate the opaque medium as the result of transitory secretory inhibition If the kidney

FIG 383



FIG 383—Calcified area in right side of true pelvis Can be easily distinguished from a shadow due to calculus in pelvic ureter or in a vesical diverticulum by the variation in density of the shadow and its irregular contour

FIG 384



FIG 384—Typical shadows of calcified (left) retroperitoneal lymph nodes Note irregular form and lack of uniform density

on the blocked side continues to function, an opaque column of urine, in acute block cases, according to Dourmashkin, can be seen above the level of the block In so-termed chronic block, excretory urography is of some aid in determining the function of the corresponding kidney and also in showing that the channel (ureteral lumen) is not completely blocked by the calculus As long as the opaque medium passes freely alongside the calculus, this indicates that grooves (Fig 378) must exist and the indications for manipulative removal or operation are less urgent, than when the ureter is well visualized (Fig 382) above the level of obstruction In other words, excretory urography is chiefly a diagnostic aid when the obstruction is more or less complete

WAX-BULB CATHETER Some urologists maintain that exploration of the ureter by a wax-bulb catheter is a positive means of locating nonopaque ureteral calculi, but this method of diagnosis has never been generally applied

The advances made in radiographic technic and the routine use of urography

and instrumental methods of examination have greatly diminished the number of extra ureteral conditions which give rise to shadows resembling by their location those due to ureteral calculi. Extra ureteral shadows which must still be taken into consideration are those due to the presence of calcified lymph nodes and of phleboliths. The shadows of the former are characterized by their irregular often notched edges and the lack of uniformity of the shadow, viz darker borders and less opaque centers (Figs. 384 and 385). Such shadows are most commonly observed in the course of the lumbar ureter (Fig. 384), less often elsewhere (Fig. 385). Shadows due to phleboliths must be remembered in the interpretation of plain films of the pelvic portion of the ureter. Phlebolith shadows are usually round of uniform density and often multiple and bilateral. Culligan found 120 phleboliths in 39 per cent and bilateral ones in 47 per cent of 1555 films of the true pelvis. As a rule, the inclusion of a shadow in the urogram indicates its intraureteral character. The close proximity of the shadow of a ureteral calculus to the opaque catheter in stereoscopic films or when shifting of the tube (Kretschmer) is employed indicate the presence of a ureteral calculus. It must not be forgotten that ureteral calculi and shadows due to extraureteral conditions may co-exist. Again, in some cases the shadow of a ureteral calculus is obscured by that of the bony structures (ribs sacrum etc.) lying behind it.

That a calcified lymph node may cause compression of the ureter has already been referred to. Another observation in connection with the diagnosis of ureteral calculi is that a lymph node in close proximity to the ureter may give rise to colicky pains simulating those due to ureteral calculi. We have observed such a case in a young man and five such cases are reported by Lachs (Zeit Urol Chir 1933 37 99).



FIG. 385—Multiple shadows due to calcified retroperitoneal lymph nodes, one of which is in close proximity to pelvic portion of right ureter. Also note shadow of calculus (intrarenal) on opposite side.

TREATMENT

We will follow the division into cases of acute and chronic ureteral block previously employed with the reservation that it should be understood that the syndromes previously described as typical of acute ureteral block may appear disappear and recur at any time during the clinical course of the so-called chronic block cases.

Treatment of Acute Ureteral Block Cases.

GROUP A. SEVERE COLICKY OR FIXED PAIN SYNDROME.

The chief objective is to relieve the pain by the administration of opiates, hot baths and so-called subaqueal colonic flushing. By the latter is meant a

method, often employed with success abroad, of giving a continuous (in and outflow) colonic flushing while the patient is immersed in a warm bath. The immediate relief of pain, following the passage of a ureteral catheter beyond the calculus, is striking. In a recent case, over 50 cc of bloody urine escaped under pressure by this method, thus showing how the acute ureterectasis and pyelocystitis cause pain. The relief of the pain is immediate. The catheter can be left in situ for a few days to prevent recurrence of pain. An opaque catheter is preferable because its coating is less apt to be roughened by the corrosive action of the urine.

GROUP B ACUTE PYELONEPHRITIS SYNDROME

Here the administration of urinary antiseptics and the administration of large amounts of dextrose solutions, by mouth, subcutaneously or by the drop (rectal) method should be first employed, supplemented in cases of severe infection by the intravenous administration of dextrose (up to 45 per cent) solutions and the use of the indwelling ureteral catheter. Cases presenting the syndromes of both Groups A and B are frequently encountered. If the acute pyelonephritis syndrome shows no evidence of subsiding in spite of the above treatment, only operative measures will be of any avail in combating a septicemia. Delay in taking such a step will often result fatally. If the calculus is easily accessible, e.g. in the lumbar ureter, a simple ureterotomy may suffice, but if the calculus is in the iliac or pelvic ureter, it is advisable not to attempt to remove it during the course of an acute pyelonephritis, but to do so later, when the patient's condition permits it. As a rule, we have found that it is preferable in these acute septic patients, to expose the kidney in order to determine the presence on its surface of multiple miliary and larger pus foci (Plate XI) and to note other acute changes such as congestion, swelling, etc., then to decide whether the kidney should be removed or only a nephrostomy be done. To expose a septic patient to prolonged search for a calculus is not good surgical judgment, in our opinion. If nephrectomy is decided upon, the use of excretory urography before the operation, only requires a relatively short time and, as a rule, yields indispensable information as to the presence of and ability of the opposite kidney to compensate for the work of both. In this connection, we again desire to call attention to the possibility that the operator must know, so far as information in such hyperacute septic cases can be obtained, whether the opposite organ is a congenitally hypoplastic one and thus unable to compensate for the work of the other, as described in the chapter on Renal Anomalies.

GROUP 3 CALCULOUS ANURIA SYNDROME

In this group, as in the preceding one, delay in following the appropriate treatment will usually result fatally. As soon as the diagnosis has been made, an attempt should be made to pass a catheter beyond the obstruction in the ureter in order to tide the patient over to a period when the removal of the calculus can be safely done. The catheter can be left in situ for several weeks, if necessary, or reintroduced if it slips out.

If, however, the anuria cannot be relieved by ureteral catheterization, efforts to dislodge the calculus by manipulative methods are inadvisable at this stage. For a variable length of time after the onset of a calculous anuria, there is a period of tolerance (see Chapter 47) which may be as short as 24 hours or as long as four weeks. This period of tolerance, in which few or no signs of reten-

tion of waste products are found on chemical examination of the blood is immediately followed by the syndrome indicative of uremia and death hence every hour of delay in the relief of an anuria lessens the chances of recovery If the ureteral catheterization method is unsuccessful it is imperative to proceed to a nephrostomy or pyelostomy unless the obstructing calculus is in the upper ureter (Fig 741) and easily reached through a lumbar incision Absence of obstruction in the opposite ureter should not delay operative measures if ureteral catheterization is unsuccessful The secretory activity of the opposite kidney is frequently inhibited by reflex action even when its ureter is not obstructed This was found to be the case in 22 of 27 cases of calculous anuria reported by Bumpus and Thompson

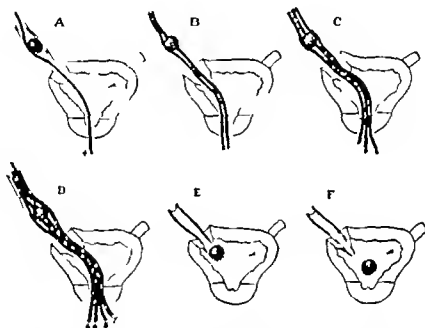


FIG. 386—A series of diagrams (A to F) to illustrate use of one or more catheters or bougies in order to dilate the ureter and deliver a calculus by nonoperative means.

Treatment of Chronic Block Cases.

Here a number of factors play a role such as the location and size of the calculus the age of the patient intolerance to manipulative methods the duration of the symptoms the degree of ureterectasis and pyelectasis and the effect of the occlusion plus infection on the corresponding kidney These will be discussed in the following sections.

Manipulative Cystoscopic Methods.

These can be divided into those which simply only aim to dilate the ureter below or at the level of the calculus and those which aim to engage the calculus and withdraw it.

1 THOSE METHODS WHICH ONLY AIM TO DILATE THE URETER. These include

- (a) Simple passage of a ureteral catheter to dislodge the calculus
- (b) Dilatation of the ureter by indwelling single or multiple catheters (Fig 386)
- (c) Dilatation with the aid of the Dourmashkin tunnelled metallic dilators or the Ravich irrigating ureteral bougies

The injection of glycerin, sterile or mineral oil, and of papaverin was formerly employed by a number of urologists in association with the passage of a single or multiple catheters to aid in the expulsion of the calculus following withdrawal of the ureteral catheters Jarman and Scott (*Jour Urol* 1937, 38, 11) have applied the observation of Waddell that avertin (tribrom ethanol) whether administered rectally or intravenously or applied to the ureteral mucosa very actively depressed the musculature and thereby relieved spasm These authors employed a No 5 ureteral catheter and two bougies or catheters of the same size or a little larger

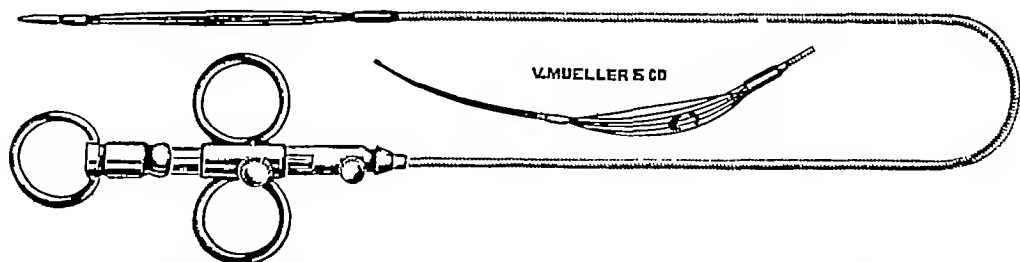


FIG 387—Councill ureteral calculus dilator and extractor The flexible instrument dilates gradually, thus minimizing injury to the ureteral wall during extraction of the calculus

and which were left in situ for 48 hours A 2 per cent solution of avertin is then injected, while warm, through the catheter into the renal pelvis and allowed to remain for 15 minutes The catheters, while being withdrawn, are slowly twisted They were successful in 25 of 27 cases by this method In both failures, the surface of the stone was rough and hence firmly engaged in the mucosa

2 THOSE METHODS BY WHICH THE CALCULUS IS GRASPED AND WITHDRAWN

(a) Passage of several catheters beyond the calculus, enmeshing it by twisting the catheters and delivering the calculus in withdrawing the catheters (Fig 386)

(b) The delivery of the calculus with the aid of the various types of extractors, which aim to engage the stone and withdraw In this class may be particularly mentioned the instruments of Councill (Fig 387), Welland, Howard (Fig 388) and Cecil

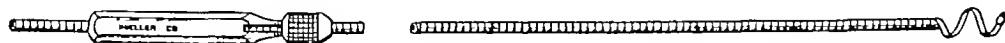


FIG 388—Howard spiral ureteral calculus dislodger with adjustable handle Flexible metal shaft (6 F) and spiral (11 F)

(c) For larger calculi in the intramural portion, Bumpus recommends meatomy, but Mathé reports a severe hemorrhage following the use of this procedure Some prefer fulguration of the meatus, but this has also the disadvantage of scar formation and consequent stenosis

DISCUSSION OF MANIPULATIVE CYSTOSCOPIC METHODS

Many ureteral calculi will be passed spontaneously within a few weeks after an attack If this does not occur, there is no danger in following an expectant treatment, provided that urological examination reveals the absence of much ureterectasis proximal to the obstruction and of little damage to the corresponding kidney Excretory urography as mentioned above is of great aid in determining the degree of obstruction

THE INDICATIONS FOR MANIPULATIVE REMOVAL

- (a) A calculus not larger than 1 cm diameter
- (b) Recurrent attacks of colic with or without concomitant transitory sepsis or anuria.

(c) Calculi in the pelvic portion of the ureter

Manipulative methods are successful in a large percentage of cases varying from 75 to 85 per cent according to reports by Herrick, Dourmashkin, Bumpus and Thompson, Ravich, Mathé, Reynolds and others if done skillfully and with great care. However if painstaking technic and the utmost gentleness are not employed serious difficulties and complications may ensue (Emmett). Thompson has repeatedly emphasized that it is not the size of the calculus but rather the diameter of the ureter which is the deciding factor and that no calculus should be manipulated if there is not sufficient room in the ureter. It should be possible to pass two No. 5 catheters easily beyond the calculus before any extractor is attempted.

FIG. 389



FIG. 390



FIG. 389.—A. Shadow (indicated by arrow) of triangular calculus in left ureter.
 B. Unsuccessful attempt to inject opaque medium or pass the ureteral catheter beyond the tightly impacted calculus. Nephrectomy and ureterotomy unavoidable because of advanced renal infection.

FIG. 390.—Diffuse papillomatosis of ureter (Courtesy of Dr. P. F. McCown)

It occurs at times as reported by Emmett (Mayo Clinic Bulletin 1937: 12: 449) that the calculus may be arrested in the ureter during its withdrawal. Too much traction is liable to be followed by injury to the ureter.

Of all of the methods of manipulative removal we believe that the use of multiple catheters is the safest in the hands of the average cystoscopist.

Severe reactions have followed attempts to remove ureteral calculi by manipulation. In general operation should be advised if delivery is impossible after 2-3 attempts by manipulative methods. Deaths from sepsis following use of manipulative methods have been reported.

Indications for Operation in Ureteral Calculi

As a result of the success of manipulative methods in 75-85 per cent of all cases of ureteral calculi, the indications for operations are far more limited in number than formerly. We do not agree with Foley, Engel and a few others who believe that all calculi "larger than a kernel of wheat should be operated." The operative indications are governed by a number of factors, as follows:

1 **LOCATION, SIZE, ETC.** If calculi are located in the upper two-thirds of the ureter and appear on consecutive examinations to be fixed, ureterotomy is advisable to forestall renal complications (hydro- or pyonephrosis). Calculi in the lower third of the ureter more than 1 cm. in diameter should also be operated. Those less than this size, can be given the benefit of a maximum of three attempts to remove them by manipulative methods, providing that an acute pyelonephritis does not call for nephrostomy and secondary ureterotomy. If calculi are bilateral, the one causing most obstruction should be operated on, lest a calculous anuria follow attempts to remove the calculus by manipulation.

2 **CONDITION OF KIDNEY.** In ureteral calculus complicated by extensive destruction of the kidney, the latter should be removed and the ureteral calculus left in situ. When the calculus blocks the ureter of a congenital solitary kidney or the remaining one (following removal on the opposite side) only ureterotomy is to be considered.

3 **TOLERATION OF MANIPULATION AND AGE.** Patients who show sharp febrile reactions following attempts to remove calculi in the lower third of the ureter by manipulative methods or older patients should be operated on.

The technic of the various operative procedures is taken up in Chapter 53.

URETERAL NEOPLASMS

Ureteral neoplasms are not always primary in the ureter. A fairly large number are secondary to neoplasms of the kidney, less frequently to those of the bladder, uterus, prostate or any other adjacent abdominal viscus. A very small number are of metastatic origin from malignant neoplasms primary in other parts of the body. We will discuss them in the order of their origin.

ORIGIN

Primary Ureteral Neoplasms

1 BENIGN

In this group are to be included polyps, papillomas (Fig. 390), granulomas and myomas. Of these, the first two are most frequently found. Including the cases collected by Melicow and Findley (*Surg. Gynec. and Obst.* 1932, 54, 680), their own case and one recently reported by Argue (*Urol. and Cut. Rev.* 1932, 38, 232), there is a record of thirty cases of ureteral polyp. Aschner up to 1921 found 21 published cases of primary benign papilloma of the ureter and a number of cases have been reported since that time. Granulomas vary from minute granular patches to papillomatous proliferations in a localized (discrete) or more widely scattered form. When located near the ureterovesical junction, as in two cases reported by Braasch (*Jour. Urol.* 1927, 18, 595) they closely simulate a neoplasm.

2 MALIGNANT

This group includes papillary and squamous-celled cancers and also sarcoma. Taylor and Kuehn (*Jour Urol* 1937 37 504) found a total of 87 reports of all types of malignant epithelial neoplasms. Sixty per cent of these were cases of papillary carcinoma. Only a few cases of sarcoma of the ureter have been reported, one of the most recent by Bergendal (*Acta Chir Scand.* 1934, 74 179).

Secondary Ureteral Neoplasms.

The most frequent seat of the primary growth is in the renal pelvis. Miller and Herbst found secondary papillary carcinoma in the ureter in 25 of 54 cases in which the primary tumor was in the renal pelvis. Invasion of the ureteral wall from a primary carcinoma of the bladder, prostate and uterus (Fig. 391) occurs



FIG. 391.—Ureteropyelograms of two cases of extrinsic obstruction of the ureter as the result of pressure in cases of uterine carcinoma. (Courtesy of Dr. Schreiner of the New York State Cancer Institute.) Note marked narrowing of the left ureter with dilatation proximal to that point in the right hand illustration and of the right ureter in the left hand illustration.

relatively often. Extension upwards from the bladder also takes place in benign papilloma.

Metastatic Ureteral Neoplasms

Kirschbaum (*Jour Urol* 1933 30 665) found 11 reported cases of metastatic ureteral neoplasms and added five personal observations. Of these 16 cases the primary tumor was in the prostate, bladder or cervix uteri in 11, and in one case respectively of cancer of the stomach, lung and Hodgkin granuloma and in two the primary cancers were in the breast. An additional case of unusual interest has been reported by Sommer (*Zeit. Urol.* 1932 26 1). The clinical symptoms in a woman 61 years old were hematuria followed by anuria. At necropsy a primary cancer of the right ureter was found with a blocking of the left ureter by metastatic deposits.

LOCATION, AGE AND INCIDENCE

Malignant neoplasms of the ureter were most frequently found in the lower portion and were associated with hydronephrosis in 67 per cent of 68 cases of primary malignant neoplasms collected by Lazarus (Ann Surg 1934, 99, 769) including three of personal cases. In 50 per cent of the 68 cases, the age of the patient was between 60 and 70 years. Extension to the regional lymph nodes, lungs and liver is not uncommon. Whether such conditions as calculi, leukoplakia and ureteritis cystica, frequently found as associated conditions in cases of benign and malignant neoplasms of the ureter, bear an etiological relation still lacks proof.

SYMPTOMS

1 Hematuria is the most commonly observed symptom, being present at the onset in 75 per cent of the cases and during the course of the neoplasms in about 96 per cent. The bleeding may occur without any preceding or accompanying symptoms, i.e., as a symptomless hematuria or it may be associated with pain of a colicky character and showing the typical radiations like those of the passage of ureteral calculi. As in renal neoplasms, the bleeding may be continuous or intermittent. It may be a gross hematuria or only demonstrable on microscopic examination. The hematuria in ureteral neoplasms cannot be differentiated from that due to renal neoplasms or other renal causes without a urological examination.

2 Pain. This also fails to present any features which characterize it as of ureteral rather than of renal origin.

3 Tumor. In some cases, a tumor mass filling the right or left abdominal quadrant and even the corresponding half of the abdomen, was palpable or had been noticed by the patient. In many such cases, the neoplasm was found to be primary in the kidney (papillary carcinoma of the pelvis) and secondary in the ureter. A hydronephrosis, which is a frequent sequel of a ureteral neoplasm, may give rise to a tumor in the corresponding kidney region.

EXAMINATION

Results of urological examination. These may be divided into

1 Cystoscopic findings

2 Data acquired by other methods of diagnosis

1 Cystoscopic Findings. The appearance of a tumor protruding from the ureteral orifice (Fig. 392) constantly or only during an efflux of urine is positive evidence of the existence of a ureteral neoplasm, but does not yield any direct information as to (a) whether the ureteral neoplasm is a primary one or secondary to a renal neoplasm. Most commonly the type of tumor which protrudes resembles a benign papilloma, but this does not indicate whether the ureteral neoplasm is of a benign or malignant papillomatous character. In a case of ureteral polyp reported by Argue (Urol and Cut Rev 1932, 38, 232) a pedunculated tumor, the size of the adult thumb, protruded from the ureteral orifice.

Cystoscopy is also of value, if blood can be seen during an efflux of urine or in the intervals, from one of the two ureteral orifices.

The presence of a tumor at the ureteral orifice was only noted in 29 per cent of 68 cases of primary malignant ureteral neoplasms collected by Lazarus.

2 Data Acquired by Other Methods of Diagnosis. These include information obtained during the passage of ureteral catheters and by urography

(a) OBSTRUCTION TO PASSAGE OF URETERAL CATHETER If other causes of resistance to the introduction of a ureteral catheter, such as calculus stricture and ureteral spasm have been excluded this finding is of much value when considered in conjunction with the findings obtained with the aid of urography. Of special importance is the tendency of ureteral neoplasms to bleed freely, when



FIG. 392.—Papilloma which was primary in the renal pelvis and secondarily implanted on the ureteral mucosa, is seen cystoscopically projecting from the ureteral orifice

even the utmost gentleness has been employed in passing a ureteral catheter. An obstruction to the passage of a ureteral catheter was reported in 38.2 per cent of the 68 cases of primary malignant neoplasms of the ureter (Lazarus)

(b) UROGRAPHY A filling defect in the course of the ureter is the most important finding of a diagnostic character in ureteral neoplasms. So far as we can ascertain these findings have thus far only followed the use of ascending (retrograde) urography

Such a filling defect or well localized change in the contour of the ureteral shadow especially if it persists at consecutive examinations is of particular diagnostic value when associated with dilatation above such a level of the ureter and renal pelvis. It is the only pathognomonic sign but was only found in 8.7 per cent of the 68 cases of malignant ureteral neoplasms collected by Lazarus.

DIAGNOSIS

This depends on the presence of some or all of the above objective findings taken in conjunction with the clinical history. The latter is of value when taken in conjunction with the appearance of a symptomless hematuria or one associated

ORIENTATION

Before the introduction of modern diagnostic methods in urology, anomalies of the kidney were only regarded as of interest to the pathologist, the majority of cases having been observed during a necropsy. At the present time, the number of clinical cases which have been correctly diagnosed has risen to several hundred for such anomalies as horseshoe kidney and a not unimportant number for other less common ones. Of all pathologic conditions, nephrolithiasis, noninfected and infected hydronephrosis, pyonephrosis, tuberculosis and neoplasms, are most frequently found as complications of renal anomalies. Of these, the three first named are most frequent, again emphasizing the part played by obstruction to the outflow of urine from the renal pelvis plus infection. Excretory urography has revealed the existence of renal and ureteral anomalies where least suspected, hence it should be used routinely preliminary to cystoscopic examination. As is true of injuries of the bladder, the majority of those of the kidney are the result of a non-penetrating force. The bleeding may only take place into the renal pelvis, giving rise to a hematuria or the blood from the ruptured viscus may escape into the perirenal fat. In a few cases, the peritoneum in front of the kidney is torn and the blood finds its way into the peritoneal cavity under a clinical picture closely resembling that of a rupture of one of the intraperitoneal viscera. The most constant symptom of a kidney injury is hematuria unless the ureter is blocked by a blood clot or torn across, so that the blood cannot pass into the bladder. The tendency at the present time is to treat kidney injuries conservatively and not to operate unless a constantly increasing anemia indicates a more radical procedure. Excretory urography is a great help in the diagnosis and prognosis of kidney injury. The role played by accessory blood vessels to the lower pole of the kidney in the etiology of hydronephrosis is fully recognized as the result of operative findings in many cases. It is possible to diagnose such a cause of obstruction by finding a filling defect in the ureterogram just below the ureteropelvic junction. The use of the newer combined cystoscopic-radiographic tables has not only enabled the urologist to decide as to whether an abnormally movable kidney is responsible for the pain of which many such patients complain as the outstanding symptom but also of the degree of stasis due to the ureteral kinking incident to a movable kidney. This advance is due to the ability to take a picture of the renal pelvis when filled with an opaque medium when the patient is standing up as well as when lying down. The indications for nephropexy, i.e. fixation of the so-called movable kidney are more strictly drawn than formerly. Only patients with distinct stasis are advised to undergo operation. Excretory urography has proven to be an excellent method of control of the success or failure of a nephropexy. A hydronephrosis may be of congenital or of acquired origin. Of the causes of the former, first rank is held by strictures of the ureter or obstruction by anomalous vessels. Of the acquired causes, calculi, tumors at the outlet of the renal pelvis, and injury of the ureter with resultant stricture may be especially mentioned. The application of better technic for plastics on the upper ureter and renal pelvis has been followed by very encouraging results in hydronephrosis, so that nephrectomy is less often employed. Nontuberculous and tuberculous infections constitute a fairly large percentage of the diseases of the kidney which are seen by the urologist. The rapid advances in bacteriologic diagnosis and the use of newer drugs like mandelic acid and sulfanilamide have made it possible to control and even cure nontuberculous infections which have hitherto resisted all previously employed methods of therapy. There is a general consensus of opinion that if a chronic tuberculous infection is limited to one kidney, a permanent cure can be obtained in over 60 per cent of nephrectomized patients. The bacteriologic diagnosis of renal tuberculosis has been greatly aided by the addition of the culture to the older staining and guinea-pig inoculation methods. In over 75 per cent of all cases of renal tuberculosis, the clinical picture is that of a chronic cystitis, hence the student must be taught to search for tubercle bacilli in every such case.

Nephrolithiasis, next to the infections, is the most common condition encountered clinically. Nonoperative methods are of no avail except perhaps to prevent recurrences through the use of diets. The diagnosis is, as in the case of ureteral calculi, especially difficult, if the calculi are of the nonopaque variety. The effects of the presence of calculi in the kidney depend to a great extent upon the degree of obstruction to the outflow of urine. A relatively small calculus which blocks the outlet of the renal pelvis intermittently or permanently will do far more damage than a large branching nonobstructing one. In the surgical treatment of nephrolithiasis as in many other pathologic conditions there is more and more of a tendency to employ conservative types of operations such as pyelotomy.

There is still much discussion as to the classification of tumors of the renal parenchyma. The theory that they are chiefly due to displaced adrenal rests is having less and less support in favor of their origin from the renal tubules themselves. The outstanding clinical sign of a kidney tumor in adults is hematuria. This is far less common in children but, on the contrary, the presence of a mass is more often the first sign in children. The diagnosis of a kidney tumor is made by the deformities of the pyelogram due to compression of the pelvis or calices by the tumor. Irradiation is only of avail in embryonal adenocarcinoma in children. In all types of tumors only nephrectomy can be recommended.

CHAPTER 32

ANOMALIES OF THE KIDNEYS

CLASSIFICATION

- ANOMALIES OF NUMBER
 - SOLITARY KIDNEY
 - SUPERNUMERARY KIDNEY
- ANOMALIES OF VOLUME
 - HYPOTPLASIA
 - SUPPLEMENTARY LOBE OR HYPERTROPHY
- ANOMALIES OF FORM
- ANOMALIES OF LOCATION
 - ORDINARY OR SIMPLE ECTOPIA
 - BILATERAL CONGENITAL ECTOPIA
 - CROSSED ECTOPIA

MEDIAN FUSION

- HORSESHOE KIDNEY INCLUDING L SHAPED KIDNEY
- W KIDNEY
- CAKE KIDNEY AND SIGMOID KIDNEY
- ANOMALIES OF ROTATION
- REDUPLICATION OF THE PELVES AND URETERS
- ANOMALIES OF THE RENAL PELVIS OTHER THAN DOUBLE KIDNEY
- ANOMALIES OF THE VESSELS
- UNCLASSIFIED ANOMALIES OF THE KIDNEY AND URETERS
- ACCOMPANYING (CONCOMITANT) ANOMALIES

CLASSIFICATION

The following classification¹ is the simplest

- 1 Anomalies of number
 - (a) Solitary kidney (Fig 393)
 - (b) Supernumerary kidney
- 2 Anomalies of volume
 - (a) Hypoplasia (Fig 396)
 - (b) Supplementary lobe or hypertrophy
- 3 Anomalies of form
 - Short long or lobulated kidneys.
- 4 Anomalies of location
 - (a) Simple or ordinary unilateral ectopia (Figs 401 and 402)
 - (b) Simple or ordinary bilateral ectopia (Fig 401)
 - (c) Crossed ectopia with (Figs 405 and 407) or without fusion (Figs 408) of the two halves.
- 5 Median fusion
 - Horseshoe kidney (Fig 412) including L shaped kidney (Fig 409) cake kidney (Fig 418) and sigmoid kidney (Fig 410)
- 6 Anomalies of rotation
 - (a) Faulty (Fig 424) and (b) excessive rotation (Fig 425)
- 7 Reduplication of the pelvis and ureters (double kidneys) (Figs 426 to 433 inclusive)
- 8 Anomalies of the pelvis other than reduplication (Fig 434)
- 9 Anomalies of the vessels.
 - (a) Of the arteries (Fig 26) and of the veins.
- 10 Nonclassifiable anomalies
- 11 Accompanying (concomitant) anomalies

We will only attempt to outline the more important clinical aspects of these various anomalies. Those interested in the subject will find a more detailed consideration in a number² of recent articles by one of us. We shall take up these anomalies in the order named.

¹ Taken from article by Papin and Ebendrath, published in *Annals of Surgery* 1927 85 735
Ann Surg., 1923 77 450 (double kidney) *Idem* 1924 76 206 (solitary kidney) *Idem*
 1925 82 735 (horseshoe kidney) *Jour Urol* 1935 33 331 (hypoplasia)

ANOMALIES OF NUMBER

SOLITARY KIDNEY

By this is meant a more or less complete lack of development of the upper urinary tract (kidney, ureter and corresponding ureteral orifice), on one side of the body. One encounters the following combinations:

A Complete absence of kidney, ureter and ureteric orifice of one side (Fig. 393)

B Same as above, but ureter ends at opposite side of bladder. There are four reported cases of this variety in which one ureter was rudimentary (Fig. 395)

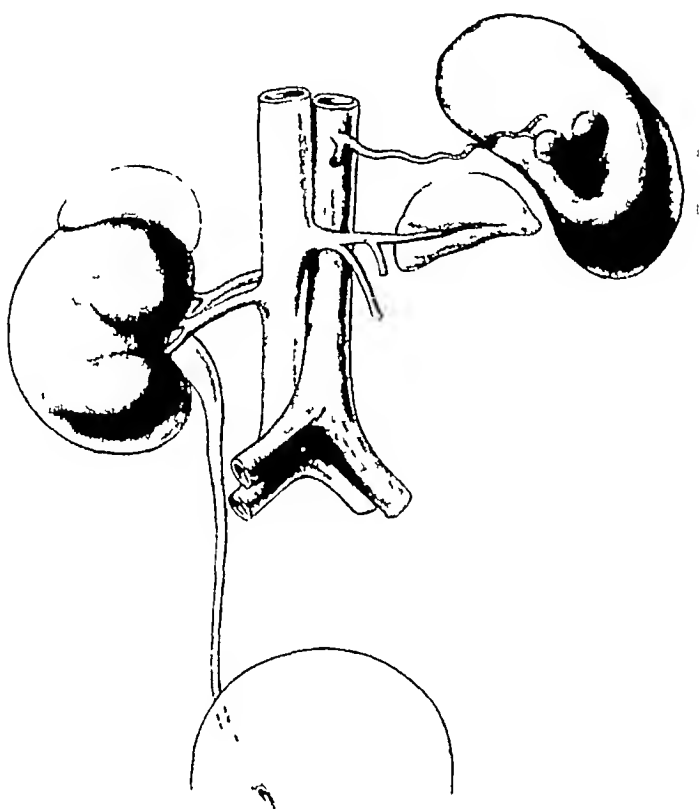


FIG. 393—Papin's case of complete congenital absence of the left kidney and ureter. The adrenal is normally developed on the aplasia side.

C Kidney alone absent. Rudimentary ureter (usually very short), ends in normally placed and developed ureteral orifice (Fig. 180). These are the cases referred to in Chapter 6 as emphasizing the possibility of error in drawing the conclusion, that a normal appearing ureteral orifice and a ureter of variable length, necessarily indicates the presence of a corresponding kidney.

D Complete absence (agenesis) of kidney, ureter and vesical orifice on one side. Opposite kidney, ectopic, and ureter ends in midline of bladder (Fig. 175).

Frequency, Sex and Number of Cases Reported

In a series of 159,274 necropsy reports which we have collected, a congenital solitary kidney was found in 167 or 1 in 953 necropsies. This incidence corresponds approximately to the incidence, 1 in 1000, noted by Sokolow in 50,198

necropsies but not to that found by Collins 1 in 337 in a survey of 337 488 necropsies The number of reported clinical and necropsy cases is now about 650 We were able up to July 1, 1937 to find 94 clinical cases in which the diagnosis was made in 43

Anatomical Considerations.

It is necessary to distinguish, first, the condition of the urinary tract and second the condition of the genitalia.

1. CONDITION OF URINARY TRACT

(a) ON THE AGENESIS SIDE, i.e. where the kidney has failed to develop

There may be absence of the kidney ureter renal vessels, ureteral orifice and corresponding portion of Interureteric ligament (Fig 179)

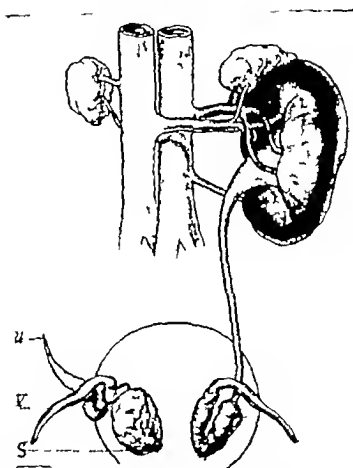


FIG. 394.—Erhardt Schmidt's case of rudimentary ureter (u) ending on agensis side in seminal vesicle (s) V is vas deferens.

The ureter is present as a cul-de-sac, or for a short distance (8-15 cm.) or in its entire length (22 cm in one case)

The ureter ends ectopically in the seminal vesicle (Fig 394) cervix, midline of bladder (Fig 175) or in the female urethra.

The adrenal is present on the agensis side in about 75 per cent of the cases

(b) ON THE SIDE WHERE THE CONGENITAL SOLITARY KIDNEY IS PRESENT

LOCATION WEIGHT SIZE AND FORM OF THE CONGENITAL SOLITARY KIDNEY The location generally corresponds to that of the normal organ but it has been found

in the iliac fossa, in the true pelvis (Fig 179) or over the median line of the spine. The weight in 87 cases (Collins) was 279.6 gms instead of the normal 150 gms. In 40 cases in which the dimensions were given, they exceeded those of the normal kidney. As a rule, the form corresponds to that of the normal organ, with a single pelvis and ureter. Two ureters and two renal pelves were noted in 11 reported cases.

The blood supply This does not differ from that of the normal kidney in the majority of cases but two clinical cases of obstruction of the ureter by vessels to the lower pole have been reported by Kirkland and by Ewell.

(c) CONDITION OF BLADDER

This presents the following variations:

The trigone is well developed and there are two normally located ureteral orifices.

The trigone is well developed but one ureteral orifice is absent (on the agenesis side).

Only half of the trigone is developed (Fig 179) corresponding to the side on which the congenital solitary kidney is located.

2 ASSOCIATED GENITAL ANOMALIES These are more frequently found in females, (206 cases) than in males (64 cases) and more commonly in association with congenital solitary kidney than any other form of renal anomaly.

The different genital anomalies will be taken up at the end of the chapter.

Clinical Aspects of Congenital Solitary Kidney

The clinical cases, thus far reported, are most conveniently placed in four groups.

GROUP 1 CASES IN WHICH THE CONGENITAL SOLITARY KIDNEY WAS ERRONEOUSLY REMOVED (9 cases)

Five of the nine were nephrectomized in the period before modern diagnostic methods were available, three others for injury of the only kidney the individual possessed and one before the advent of excretory urography, ureteral catheterization being impossible because of a urethral stricture.

GROUP 2 CASES WITHOUT ANURIA ALL OF WHICH WERE OPERATED (35 cases)

GROUP 3 CASES WHICH PRESENTED ANURIA AS THE OUTSTANDING SYMPTOM (30 cases)

GROUP 4 CASES WHICH WERE ONLY DIAGNOSED (20 cases)

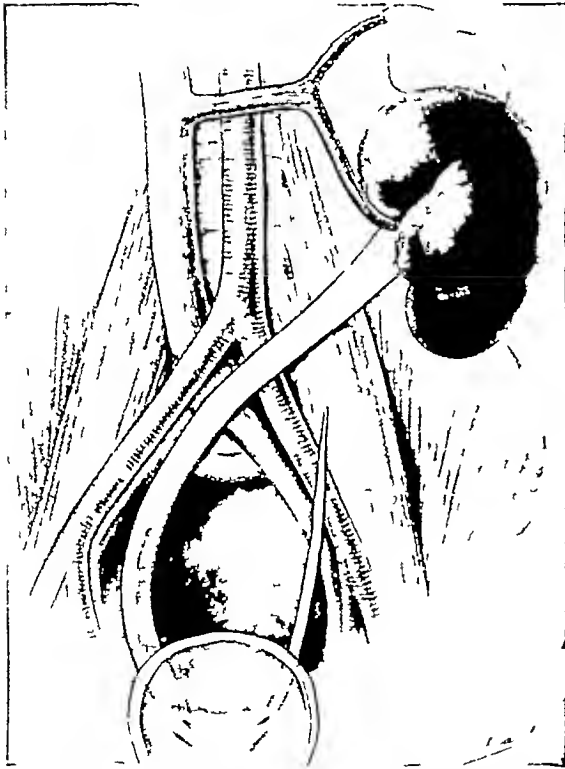


FIG 395—Horand's case of congenital solitary (left) kidney whose ureter ends at ureteral orifice on opposite side of bladder. There was a rudimentary ureter ending blindly above but having a normal appearing ureteral orifice, on the congenital solitary kidney side. There are four published cases of this important anomaly.

Diagnosis.

This includes the following

1 **HISTORY** Heredity only plays an insignificant part in this type of anomaly. The history of an operation for absence of the vagina led to the search for a congenital solitary kidney by Gutierrez.

2 **ENLARGED KIDNEY ON ONE SIDE.** This finding on bimanual palpation is of little value even if no kidney can be felt on the opposite side.

3 **EXAMINATION OF GENITALIA.** This is of considerable value if absence of the vagina or urethra (female) are found or if anomalies of the internal genitalia were noted during laparotomy for gynecologic conditions. In the male malformation of the penis, urethra, unilateral absence or atrophy of testis, half of prostate or of one seminal vesicle are valuable data.

4 **RADIOGRAPHY, CYSTOSCOPY AND URETERAL CATHETERIZATION.** Plain radiography is only of importance if a large kidney shadow is to be seen on one side and none on the other and then only if corroborated by other findings. If a calculus is present this method has its usual value. Cystoscopy may reveal the absence of the ureteral orifice accompanied by failure to show excretion of indigo-carmin or urinary efflux on the agenesis side in the majority of cases. In a relatively small number a ureter of variable length as described above is found on the agenesis side hence the presence of two ureteral orifices does not always indicate the existence of two kidneys.

If only a single ureteral orifice is found in the bladder one must always keep in mind that the ureter of the other kidney may end ectopically as described under Anomalies of the Ureter.

EXCRETORY UROGRAPHY is of much value provided that the secretory activity of the congenital solitary kidney is not temporarily inhibited by a calculous obstruction or other cause of anuria. In two reported cases (Gutierrez, Ewell) the diagnosis of congenital solitary kidney was made by this method the absence of any shadow on the side on which an absence of the ureteral orifice being noted.

URETERAL CATHETERIZATION should be a routine procedure in anuria in patients with congenital solitary kidney even though plain radiography fail to reveal a shadow. One of us has recently encountered such a case.

ASCENDING (RETROGRADE) UROGRAPHY should only be done in cases without anuria or after the latter has been relieved. This method is of value in determining the presence of pathologic conditions as well as the location of the solitary kidney. Quite often the anomaly termed faulty rotation is associated with congenital solitary kidney (Fig 180).

Treatment.

This varied according to whether or not an anuria was present as the chief clinical feature.

GROUP 2. CASES WITHOUT ANURIA. The lesions found were in the order of frequency nephrolithiasis associated or not with hydro- or pyonephrosis, pyelonephritis, tuberculosis, obstruction by anomalous vessels, tuberculosis and injury. The operations were all of a conservative type as would be expected.

GROUP 3. CASES WITH ANURIA. Of the 30 reported cases the diagnosis was made at operation (nephrotomy, pyelotomy, ureterotomy, decapsulation or ex-

ploratory) in twelve. In the majority of the 30 cases, the anuria was due to calculous obstruction or stricture of the ureter. The treatment of anuria in cases of congenital solitary kidney includes, first, an attempt to introduce a ureteral catheter beyond the point of obstruction and then to leave it in situ until the normal output has been reached. If the catheter cannot be passed beyond the obstruction or is constantly expelled immediate ureterotomy, pyelotomy or



FIG 396—Plain film and photograph of operative specimen in case of renal hypoplasia. A Shadows of four large ureteral calculi. B Miniature kidney in boy eleven years old and greatly dilated ureter filled with calculi. (Compare with A.)

nephrostomy must be done followed by secondary removal of the calculus, except when the latter can be easily removed at the primary operation.

THE RESULTS in the 30 cases of anuria were as follows: Ureteral catheterization, 7 cases, all recovered, same method followed by ureterotomy, pyelotomy or nephrotomy 5 cases, all recovered, ureterotomy alone, 3 cases, all recovered, primary nephrotomy or pyelotomy, 10 cases, 1 fistula, 5 deaths, one 18 months after a second nephrotomy, fulguration of ureterocele 1 case, recovered, decapsulation, 1 case, death, exploratory only, 2 cases, 2 deaths, type of operation not given, 1 case.

SUPERNUMERARY KIDNEY

When one speaks of supernumerary kidney only such cases should be included in which a structure is found on one or both sides of the median line of the body, with the following characteristics

- (a) Resemblance to kidney in every particular
- (b) Own blood supply and excretory duct
- (c) Complete separation from kidney of same side

In many of the reported cases, the supposed supernumerary kidney was the upper half of a double kidney (see later)

If we adhere closely to the above requirements it leaves only 28 true cases. These can be divided into two groups (a) condition found at autopsy and (b) at operation. It is to be regretted that so few of the true case reports are accompanied by illustrations of the condition. If this were the case probably some of those which after careful inspection of the original articles seemed genuine cases might also be found to be instances of double kidney. In only two of the clinical cases was a diagnosis made before operation. As is the case with other renal anomalies the organ is especially apt to be the seat of calculus formation and infection owing to inadequate drainage conditions.

ANOMALIES OF VOLUME

HYPOPLASIA

By this is meant an anomaly in which there is a lack of development of the kidney whereas in congenital solitary kidney or aplasia, there is a complete failure of the organ to develop on the agenesis side no traces being demonstrable even on histologic examination.



FIG. 397.—K. V. Wolff's case of enormous left hydronephrosis with opposite congenital renal hypoplasia; the kidney being found in posterior wall of bladder.

Anatomical Considerations.

Two types or forms of congenital hypoplasia have been found

TYPE 1 Cases in which there is a structure which resembles (Fig 396) in every detail the pattern of the fully developed kidney including a ureter and renal pedicle. In such cases the hypoplastic kidney is simply a miniature of the normally developed organ. One might speak of it as being the same relation to the latter that a dwarf bears to the fully developed adult.

TYPE 2 Cases in which only traces of the various components (glomeruli and tubules) of the parenchyma can be found on histological study or as in several of Gutierrez cases (Arch Surg 1933 27 686) by the presence of dis-

crete shadows in the kidney region, following intravenous (excretory) urography

Incidence, morphology, etc

In a total of 63,076 necropsies, this anomaly was found 77 times or 1 to 816 necropsies. The form of the hypoplastic kidney often resembles that of the normally developed organ but it is much smaller, varying in size from that of a pea to that of a plum. There is a corresponding diminution in the weight.

LOCATION As a rule, the kidney is found in the normal location but it may occupy a much lower position as in the case shown in Fig 397 where it was found adherent to the posterior wall of the bladder. In some cases, there is only a single pyramid, in others two. On section, the normal demarcation into cortex and medulla are seen, but both are present in miniature form. In a few reported cases, both medulla and cortex varied from 1 mm to 1 cm in width.

The renal pelvis is present, but atypical in form. This will be taken up under urographic diagnosis. The ureter may be partially or completely obliterated or be absent altogether. Marked ureterectasis (Fig 396) and ectopic ending of the ureter have been reported.

HISTOLOGIC EXAMINATION reveals considerable variation in individual cases, thus

- 1 Cases with only a mass of fatty fibrous tissue, a few cysts but no glomeruli or tubules
- 2 Few or no glomeruli, but many tubules, some of which are arranged as in the fully developed kidney, while in another field, one only sees sclerotic fibrous tissue and tubules irregularly arranged as in the kidney of the embryo. There is a tendency to cyst formation.
- 3 Many glomeruli, some with hyaline degeneration and also many sclerotic blood vessels, but few tubules.

Pathologic Lesions of Hypoplastic Kidney

These do not differ from those seen in the fully developed organ. In the order of their frequency, they are hydronephrosis, calculus formation, nontuberculous and tuberculous infection.

CLINICAL ASPECTS We have found reports of 22 cases, in which nephrectomy was performed for pathologic conditions in hypoplasia.

In 3 cases, the clinical symptoms were due to the pathologic condition of the ureter, in the form of an empyema (Oehlecker's and Haslinger's cases) or to multiple ureteral calculi (Fig 396) rather than to a lesion in the hypoplastic kidney.

We were able to find (Jour Urol 1935, 33, 331) reports of 17 cases in which death from uremia or anuria followed operations on the opposite fully developed kidney at intervals varying from a few days to nine years. When the normally developed kidney is unable to function as the result of acute or chronic pathologic changes (Figs 397 and 398) or its ureter is blocked (See Chapter 47), the burden of compensating for this temporary or permanent disturbance of function is thrown upon the congenitally hypoplastic kidney, which is unable to do so in the majority of cases.

Symptoms.

The clinical pictures observed in the various pathologic conditions found in hypoplastic kidneys do not differ from those due to the same lesions of the fully developed organ. In three of MacKenzie's cases the preoperative diagnosis was an occluded renal tuberculosis because of pain frequency or hematuria. It was impossible to catheterize the ureter on the hypoplastic side.



FIG. 398.—Weber's case of right hypoplastic kidney and marked pyonephrosis on opposite side. Patient died of uremia, two days after admission to hospital.

Of the remaining 16 cases fixed pain over the kidney seems to have been the chief symptom in 4 cases. In 12 cases, the complaints were in addition to fixed or colicky pain the usual ones incident to infection of the urinary tract.

Diagnosis.

UROGRAPHY. Excretory urography may yield information as to the presence of a few secreting tubules on the hypoplasia side and also as to the rudimentary type of pelvis on that side (Fig 399)

ASCENDING UROGRAPHY is the method of choice. The types of pelvis which should make one think of the existence of a congenital hypoplastic kidney are

3 ILIOLUMBAR The kidney lies across the crest of the ilium (Fig 402)

ILIAC The entire kidney is found in the iliac fossa (Fig 400)

ILIOPELVIC The kidney is found at the level of the brim of the true pelvis

PELVIC The entire kidney lies in the true pelvis either over the sacral promontory, in the concavity of the sacrum or on the floor of the pelvis (Figs 401 and 403)

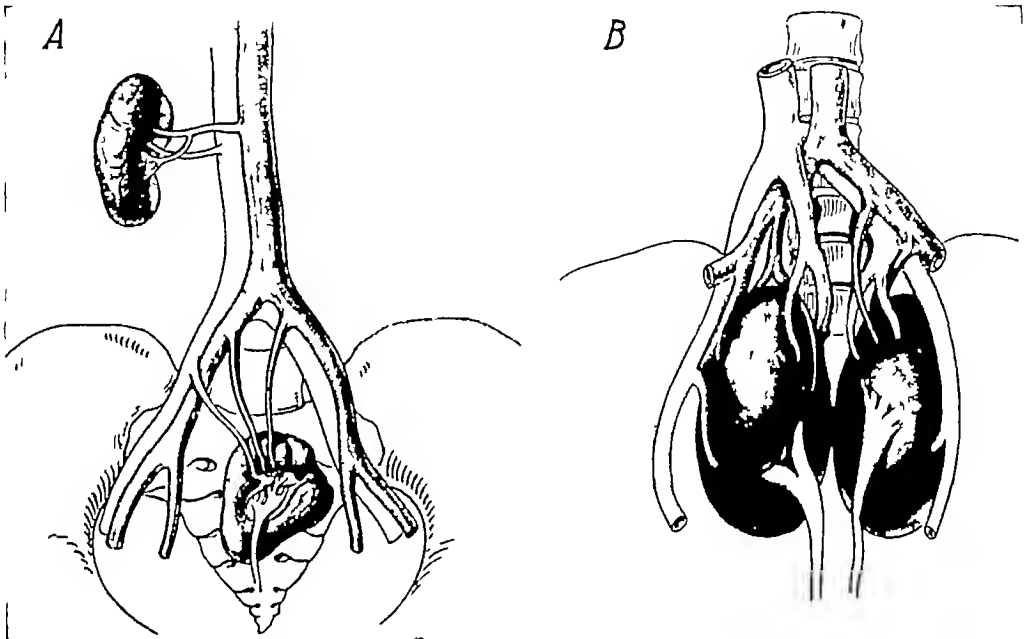


FIG 401—A Typical pelvic congenital ectopia Note vessels arising below bifurcation of aorta (Hochenegg's case)

B Papin's case of bilateral congenital pelvic ectopia Note origin of vessels from iliac artery and vein

Of all of these six locations of the ectopic kidney, the pelvic is the most frequent

In addition to the above, the kidney has been found lying behind the aorta, and also accompanying the sac of an inguinal hernia

Anatomical Considerations

URETER AND RENAL PELVIS The length of the ureter varies according to the location of the kidney In pelvic ectopic kidneys, the average length is 10 cm

In most cases, the hilus is directed forwards, i.e. ventrally, seldom backwards There is rarely a true pelvis, the major calices uniting to end directly in the ureter as in Fig 400

FORM AND SIZE The kidney is almost always flattened, disc-like with the fetal lobulations much more marked than in the case of the normally located organ It may be so poorly developed as to be overlooked (Figs 396-398 inclusive) unless search is made for it or its location determined during a urological examination

BLOOD SUPPLY The arteries and veins have their origin and termination, respectively, in immediately adjacent vessels

This characteristic feature of a congenitally ectopic kidney distinguishes it

from the acquired ectopic location (see Chap 35) as found in cases of movable kidney. Only two exceptions to the existence of a very short pedicle and a minimal range of mobility of the congenitally ectopic kidney have been reported.



FIG. 402.—Specimen showing a right-sided thorolumbar renal ectopia. Note artery to upper pole from the lower portion of the aorta and a second artery to the hilum from bifurcation of the aorta. Also note the pelvis on ventral aspect of the ectopic kidney.

BILATERAL CONGENITAL ECTOPIA

Up to July 1, 1937, 33 cases have been reported. All possible combinations as to the location of the two kidneys were found, but in the majority both were found in the true pelvis.

Associated Genital Defects. These are relatively uncommon and will be taken up later.

Clinical Aspects

Every pathologic condition found in the normally located kidney is found in the congenitally ectopic one. The most common lesion, in the order of their frequency, are nephrolithiasis with or without a concomitant ureterolithiasis, pyelonephritis, pyonephrosis, hydronephrosis, and neoplasms.

We have found reports of 117 cases in which nephrectomy and 34 cases in which other types of operations were done for various pathologic conditions

Symptoms

A convenient division for clinical purposes is into

- 1 Cases presenting symptoms referable to the urinary tract
- 2 Those which simulate gynecological or other abdominal conditions
- 3 Those which give rise to symptoms during pregnancy or to dystocia
- 4 Latent cases, in which the ectopic kidney is found during operations for other conditions

1 CASES PRESENTING SYMPTOMS REFERABLE TO THE URINARY TRACT None of these are pathognomonic for the existence of this type of anomaly In 29 (32.9 per cent) of 88 clinical cases observed at the Mayo Clinic (see Thompson and Pace,

loc cit) the patients complained of recurrent attacks of pain, which were atypical in character and radiation In others, the symptoms were those incident to the presence of pathologic changes in the ectopic kidney

2 SIMULATION OF GYNECOLOGIC AND OTHER ABDOMINAL CONDITIONS There are many reports of cases, in which a mass was felt at the level of the various locations of ectopic kidneys mentioned above When pathologic changes, especially infection, occurred, the clinical pictures simulate those of gynecologic conditions (pelvic ectopia) or of appendicitis (iliac ectopia) When only a mass was palpable, the ectopic kidney has been mistaken for a mesenteric cyst, etc

3 SYMPTOMS DURING PREGNANCY OR DYSTOCIA Although the mere presence of an ectopic kidney in the true pelvis does not necessarily give rise to symptoms during pregnancy or labor, a sufficiently large number of cases have been reported to justify bearing such a possi-

bility in mind Death following rupture of the uterus during labor has been reported, the first by Albers-Schonberg in 1894 Obstruction to engagement of the presenting part, most often the head, has served as an indication for various obstetrical operations, most frequently cesarean section Symptoms ascribed to the presence of a pelvic ectopic kidney have necessitated nephrectomy or displacement of the kidney followed by nephropexy and induction of labor In two cases (Hohl, Ramos) the diagnosis of the cause of obstruction was recognized by palpation and urography, before cesarean section

4 LATENT CASES In this group, the presence of a congenital renal ectopia was incidental either to abdominal exploration for other conditions or to a urologic examination



FIG 403—Urogram from case of right congenital (pelvic) ectopia of kidney Note normal location of opposite kidney

Diagnosis

The data upon which a preoperative diagnosis was made in 34 clinical cases

- (a) Abnormal location of shadows of calculi one case
- (b) Same followed by observation of course of an opaque ureteral catheter to the abnormally located shadow, four cases
- (c) Palpation of a mass behind uterus three cases
- (d) Urinary fistula in cul de sac associated with mass one case
- (e) Ascending (retrograde) urography alone 22 cases



FIG. 404.—Urogram from case of right ilio-lumbar congenital renal ectopia (see text) and specimen showing typical cake like flattened shape of such kidneys. Also note hilum on ventral aspect of the kidney and absence of a pelvis proper: the three principal calices uniting to form the ureter.

(f) Excretory urography alone two cases

(g) Ascending and excretory urography combined one case

In the rest of the reported clinical cases, the diagnosis was made during surgical exploration for other conditions or is not mentioned.

CROSSED ECTOPIA

Under normal developmental condition the renal blastema of each side and its ureter migrate upwards to reach the final location in the respective lumbar region. An arrest somewhere of the human metanephros in this course results in the anomaly, ordinary ectopia just discussed. Such an arrest may involve both embryonic kidneys. In either case uni- or bilateral ordinary ectopia the kidney always remains on the same side of the body as that on which it develops during early embryonic life.

In crossed ectopia the nephrogenic mass or renal blastema, for some reason

not yet found, instead of moving directly upwards on its respective side of the median line with the growth of the embryo, is deviated toward the opposite side of the body. The kidney which remained on its own (where formed) side is termed the fixed, whereas the other, which has crossed to the opposite side, is termed the ectopic one. The result of these developmental errors is the presence of both kidneys on the same side of the body. The two kidneys may be separately developed (C of Fig 405) or their nephrogenic masses become fused to form, to all external appearance, a single kidney (A and B of Fig 405). The ureters do not

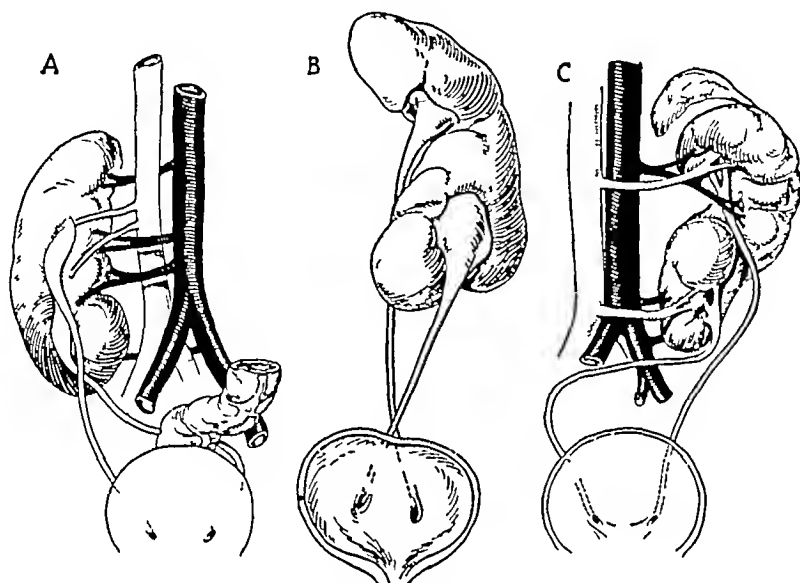


FIG 405 —A Stocquart's case of crossed ectopia with complete fusion of the two kidneys. Note the ventral pelvises.

B Mennacher's case of complete fusion. One pelvis directed mesially and the other ventrally.

C Brocsike's case of complete fusion with one pelvis directed mesially and the other laterally (outwards).

unite, but follow a separate course ending on opposite sides of the bladder. The ureter of the lower (ectopic) kidney is as a rule the one which crosses the median line (Fig 406) to end in the opposite side of the bladder. The term "unilateral fused kidney" is still wrongly employed in some reports to designate this type of anomaly, but if used at all, it should only refer to cases of double kidney (see later).

Incidence, Sides and Sex

Stewart and Lodge (*Brit Jour Surg* 1923, 11, 27) found only one crossed ectopia in 6500 necropsies. The number of clinical cases has increased rapidly in the last 20 years. Townsend and Frumkin (*Urol and Cut Rev* 1937, 41, 324) collected 159 cases of crossed ectopia, of which 82 were found at necropsy and 77 clinical cases. To the latter, we can add 65 other clinical observations not included in their table or published since then.

In the 159 cases (necropsy and clinical) collected by Townsend and Frumkin, the age of the patient varied from nine days to 79 years, the average being 31.4 years. The anomaly was found on the right side 96 times and on the left, 43 times, the side not being given in 10 reports. Of 142 cases where the sex is mentioned, 98 were males and 54 females.

Anatomical Considerations.

RELATION OF THE TWO KIDNEYS TO EACH OTHER The two halves have been found as follows

- (a) Placed end to end (Figs 405 and 407)
- (h) At an acute angle to each other
- (c) By their outer borders i.e. overlapping each other
- (d) At right angles (L-shaped form)

There are as many variations possible as there are degrees of rotation of the component halves. As a rule the fixed organ lies more cephalad, i.e., above the ectopic one but the opposite condition has been found in seven cases by Pagel (loc. cit.) i.e., the ectopic kidney lies above the fixed (normal) one. There is much variation of the location of the mass especially of the ectopic half. It may be found in the iliac fossa or across the pelvic brim or even in the true pelvis. One portion usually the lower, is deformed its anterior surface being lobulated and its borders irregular.

MODE OF UNION There are two types of cases

(a) Those in which there is such an intimate fusion of the two halves (Figs 405 and 407) that no line of demarcation exists and the mass appears at first glance to be a more or less normal kidney.

(b) Those which are completely separated. Pagel found this condition in eight of fifty five cases i.e. 14.5 per cent (Fig 408).

DIRECTION IN WHICH HILUM FACES There is no rule about this. One finds the following combinations

(a) Both face more or less ventrally (forwards) (A of Fig 405)

(b) One ventral and the other mesial. Very common. (B of Fig 405)

(c) Both face mesial (inwards) (Fig 408)

(d) One ventral and the other lateral (outwards) (C of Fig 405)

(e) One faces mesial and the other lateral (Fig 407)

(f) Both face posteriorly (only found in three cases). There may be no true pelvis only extrarenal calices unite to end in the ureter.

LENGTH OF KIDNEY This is usually more than that of one kidney alone but never that of both kidneys. Occasionally the entire mass is smaller than that of one kidney alone.



FIG. 406.—Urogram from case of right crossed ectopia. Note how the ureter arising from the lower (ectopic) kidney passes across midline to end in opposite (left) side of bladder (Courtesy Dr. P. Rosenblum.)

MODE OF ORIGIN AND ENDING OF URETERS As a rule, the ureter of the upper or fixed kidney, ends in the corresponding side of the bladder and that of the lower or ectopic organ, on the opposite side. There are seven published cases (Papin) in which the ureter of the upper or of the lower half, ended in the opposite side of the bladder. This occurs especially as pointed out above, when the lower is the fixed kidney, so that its ureter opens on the corresponding side of the bladder. The

ureter may follow an indirect course from the upper kidney, around the lateral (outer) border of the lower kidney (Broesike's case). The ureter may pass behind the rectum in crossing to the opposite side.

BLOOD VESSELS There

FIG 407

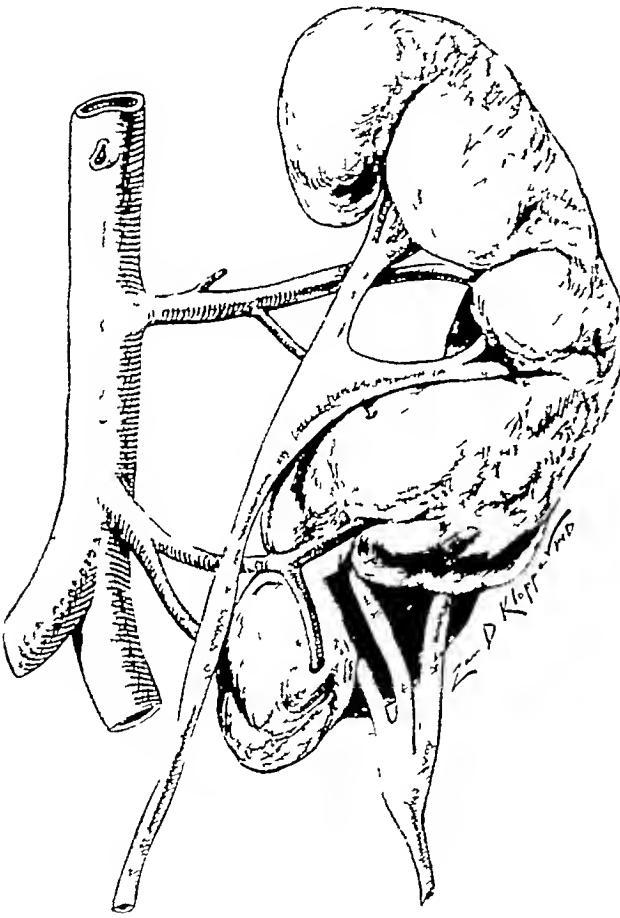


FIG 407—Fusion of the two halves of a crossed ectopic kidney. Note mesially directed pelvis of upper and ventrally directed pelvis of lower half (Rush Medical College Museum)

FIG 408

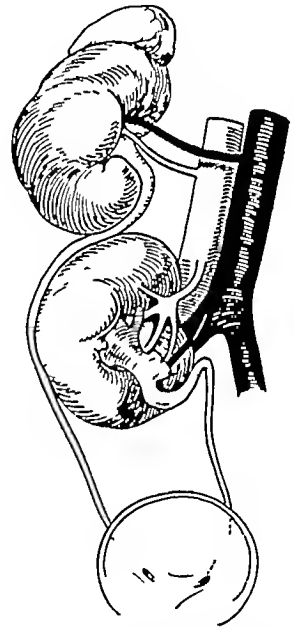


FIG 408—Crossed ectopia with absence of fusion of the two halves

was a single vessel to each half in six and multiple vessels (two to six) in thirty-two cases studied by Papin and Palizoli. As a rule, the vessels arise from the aorta, but may be given off in part or entirely, by the iliacs.

GENITAL DEFECTS These are not as frequent as in solitary kidney and will be considered later (see accompanying anomalies).

Clinical Aspects

As in the case of other anomalies of the kidney, there are no symptoms which are pathognomonic of this or that type of anomaly. This is especially true of crossed ectopia. In looking over the 142 reports of clinical cases, the most frequent symptoms noted did not differ in any respect from those found in various patho-

logic conditions involving kidneys not presenting any anomalies in location. In the 51 cases which were operated the patients complained of recurrent attacks of pain in the upper or lower abdominal quadrant of the side where the crossed ectopia was located in 7 cases. In 5 others the pain was associated with a palpable mass, in 7, a colicky pain and a shadow due to a calculus were noted.

In one case the preoperative diagnosis was movable kidney and in another chronic nephritis (hematuria and casts). In two cases the symptoms and examination led to a diagnosis of renal tuberculosis. No pre-operative symptoms were given in the other reports. The pathologic conditions found at operation included all of those observed in nonanomalous conditions including echinococcus in one case. As in all anomalies of the kidney, lithiasis acute and chronic pyelonephritis pyonephrosis and hydronephrosis were most frequently noted.

Diagnosis.

As in the case of the preceding anomaly ordinary ectopia very little reliance can be placed on the symptoms or results of physical examination (palpation in particular). In the 51 cases which were operated a preoperative diagnosis of crossed ectopia was made in thirty in four by the deviation of the opaque catheter (Fig. 406) in five, by this method supplemented by ascending urography by excretory urography alone or ascending urography alone or the two combined in 20 cases and by pyeloscopy in one case. The diagnosis was made during surgical exploration in twelve cases. In nine cases no mention is made of how the diagnosis was made.

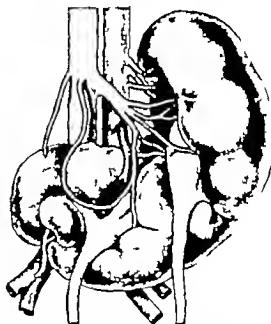


FIG. 409.—Typical L-shaped horseshoe kidney. The right half is very small and at a lower level than the left half.

Treatment.

This varies according to the lesions found in the individual case. In 19 of the 51 operated cases the upper or lower segment of the mass was removed, in five a pyelolithotomy was done for calculus and in seven, a nephropexy. In one a ureterolithotomy and in another a primary pyelotomy and secondary removal of the diseased segment were done. In four cases a urological examination was not made before operation. The mass was thought to be a single kidney and was removed. Death from anuria followed rapidly.

MEDIAN FUSION

HORSESHOE KIDNEY

When the two masses of nephrogenic tissue (Fig. 4) i.e. the renal blastemae or anlagen instead of remaining separate (see Chapter 1) should fuse along their mesial borders to a greater or lesser extent (Fig. 412) so that one half extends

beyond the midline of the body, we speak of the resultant anomaly as one of median fusion. The familiar horseshoe kidney constitutes the majority of such anomalies. Such a median fusion is composed of two parts termed halves, connected by a band or bridge of tissue, referred to as the isthmus. The anomalies termed L, sigmoid and cake kidneys, are simply variations of the median fusion.

In a crossed ectopia, the lower kidney (Figs 405 and 407) may approach the midline or even extend beyond it slightly. As a rule, however, the entire mass lies to the left or right of the midline of the spine. In double kidney, both halves lie similarly, i.e., entirely on one side of the body. The term fused kidney has been used in such a confusing and indiscriminate manner, that it is being discarded in favor of the now generally understood and accepted terms, of horseshoe kidney (or median

FIG 410

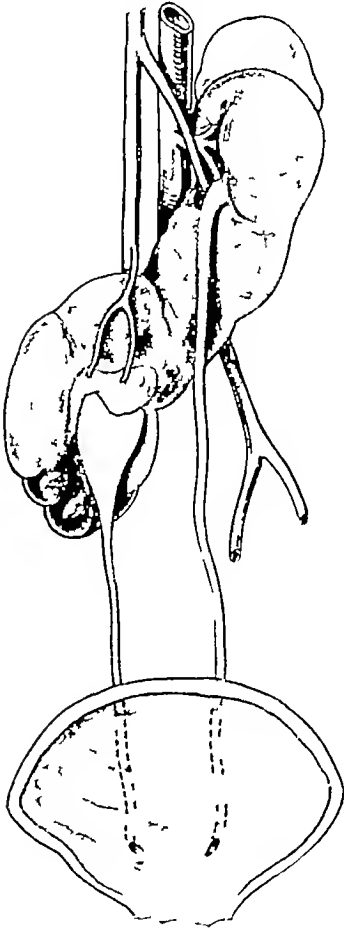


FIG 411

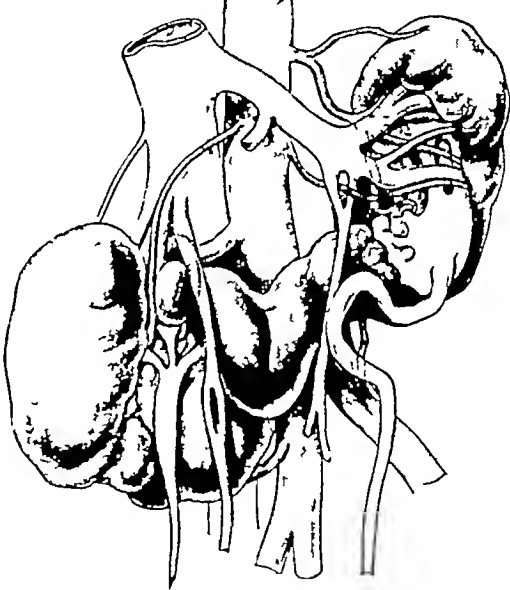


FIG 410—Winternitz' case of sigmoid type of horseshoe kidney. One half is much higher than the other.

FIG 411—Marked asymmetry both as to location and size of the two halves of a horseshoe kidney (Papin's case).

fusion), crossed ectopia and double kidney. These represent three entirely different anomalies.

Incidence

Reports of various authors which we have been able to collect, show that in 114,802 necropsies, horseshoe kidney was found 178 times or 1 to 644 necropsies. In addition we have found records of 250 clinical cases.

Anatomical Relations

Size and relation of the halves

(a) Symmetric. Both at same level and of equal size (Fig 412). The isthmus

is inferior in ninety per cent, and superior, i.e., joining the upper poles, in ten per cent of the cases

(b) **Asymmetric** Both at different levels. The halves may be of equal (Fig 412) or different size (Fig 411) The L-shaped kidney should not be placed in a separate group of onomalles. It is simply an asymmetric horseshoe kidney (Fig 409)

The cake kidney is the result of complete fusion along their mesial borders of the two halves of a horseshoe kidney. There is only one example of a sigmoid kidney (Winternitz case) and this also must be regarded as a variation of horseshoe kidney

AXES AND RELATION OF HALVES TO SPINE
In the case of the two normal kidneys, their long axes are directed obliquely downwards and outwards (see Chapter 2) so that they are nearest to each other at their upper poles. The opposite is usually true of the two halves of a horseshoe kidney. This explains why calculi (Fig 413) are located obliquely. In a few cases the axis of each half was quite vertical and a calculus shadow correspondingly so. As a rule the two halves are located close to the spine (Fig 414) and one-half may lie directly over the spine (Fig 415). One cannot rely upon this relation because in a number of clinical cases one-half has been found in the location of the normal kidney and the other half close to the spine. Again both halves have been found as far from the spine as the two normal kidneys. These anatomic observations are of much importance in the interpretation of the location of calculus and of pyelographic shadows.

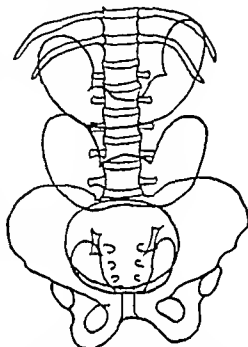


FIG 412—Diagrammatic representation of various levels at which horseshoe and cake kidneys are found (Papan)

Location and Fixation of the Horseshoe Kidney The organ may lie at the following levels

(a) At that of the normally placed and developed kidneys. Only seven instances have been reported

(b) Most common level is at or close to aortic bifurcation (third to fifth lumbar vertebrae) (Fig 412)

(c) Over promontory of sacrum or even in the true pelvis (Fig 412). These are usually examples of cake kidneys

Although there is very little perinephric fat, the horseshoe kidney is well fixed as the result of the short vessels supplying it.

PARENCHYMA, PELVIS AND CALICES The pyramids are arranged in a frontal instead of a sagittal plane hence some of the calices are directed mesially (Fig 414) an observation of much clinical import (see Diagnosis). There are also apt to be a larger number of calices directed ventrally (Fig 416) as the result of faulty rotation of the kidney. In the majority there is only a single pelvis for each half but reduplication (Fig 419) is not rare. The pelvis is as a rule on the ventral (anterior) aspect. In many cases there is no pelvis proper i.e. only a

series of extrarenal calices which unite to end in the ureter. The isthmus (Fig 420) may contain one or more calices.

THE ISTHMUS AND BLOOD VESSELS The isthmus connects the upper poles in ten per cent and the lower in ninety per cent of all cases (Fig 420). Its width varies from that of a thin band of fibrous tissue, to one composed entirely of parenchyma (with a few calices) uniting to a variable extent, both halves. The extreme cases of median fusion are termed cake kidney (Fig 418). The average width of the isthmus is 3 cm. The isthmus usually lies in front, but rarely (in two cases) may lie behind the aorta and vena cava.

FIG 413



FIG 413—One of our cases of horseshoe kidney. Note the typical pyelogram on left side of illustration, of a hydronephrosis of right half and the obliquely arranged shadows of multiple calices, in pelvis of left half.

FIG 414



FIG 414—Bilateral pyelograms of case of horseshoe kidney. Note mesially directed calices in both halves and how right half extends across the body of third lumbar vertebra. One (right) pelvis is much closer to midline than the other.

There is much more variation in the blood supply of the horseshoe kidney than in the case of the normal kidney. Papin found that in forty of 139 specimens there was one artery for each half and one for the isthmus. Multiple arteries for each half and the isthmus, are a common occurrence.

THE URETER As a rule, this passes in front of the isthmus (Fig 409) rarely behind it (Fig 421). Occasionally there is a separate ureter for the isthmus. The ureters usually diverge from the midline of the body much more than do the normal (Fig 15). This is of much importance from the diagnostic standpoint (Fig 415). The ureter is very apt to open into the pelvis at a high level (Fig 420) thus favoring stagnation.

(a) **MODE OF ORIGIN AND COURSE OF THE URETER** The ureter usually arises from the middle of the ventral aspect (Fig 409) of the renal pelvis and not from



FIG. 415.—A. Location of opaque catheters in case of horseshoe kidney. Note how catheter in right ureter curves inward at sacro-iliac joint and runs upward along middle of anterior aspect of lumbar vertebrae to end opposite interspace between second and third.

B. Pyelograms (bilateral) of same case. Note location of pelvis of right half over body of third lumbar vertebra. Also observe wide distance of pelvis of left half (with its mesially directed calices) from the vertebrae.

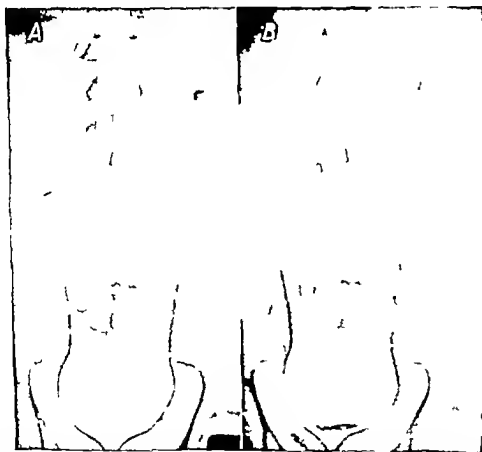


FIG. 416.—A. Shadow of calculus in case of horseshoe kidney. Note high location of the shadow over twelfth rib.

B. Left pyelogram of same case. Note location of this half of the horseshoe kidney at about level of normally placed and formed kidney. Note entrance of ureter along lateral border of pelvis and also the ventrally directed calices, i.e., none are mesial as one usually finds in horseshoe kidneys.

its most dependent point as in the case of a normal kidney (Fig 145) There may be only a number of extrarenal calices in place of a renal pelvis proper The course of the ureter across the front of the isthmus (Fig 420) and its frequent fixation to that structure, also favor obstruction to urinary outflow

THE PRESENCE OF ACCESSORY VESSELS also may interfere with the escape of urine (See Chapter 34)

URETERAL STRICTURES AND KINKS These probably do not play any greater role than in the case of a normally developed and located kidney

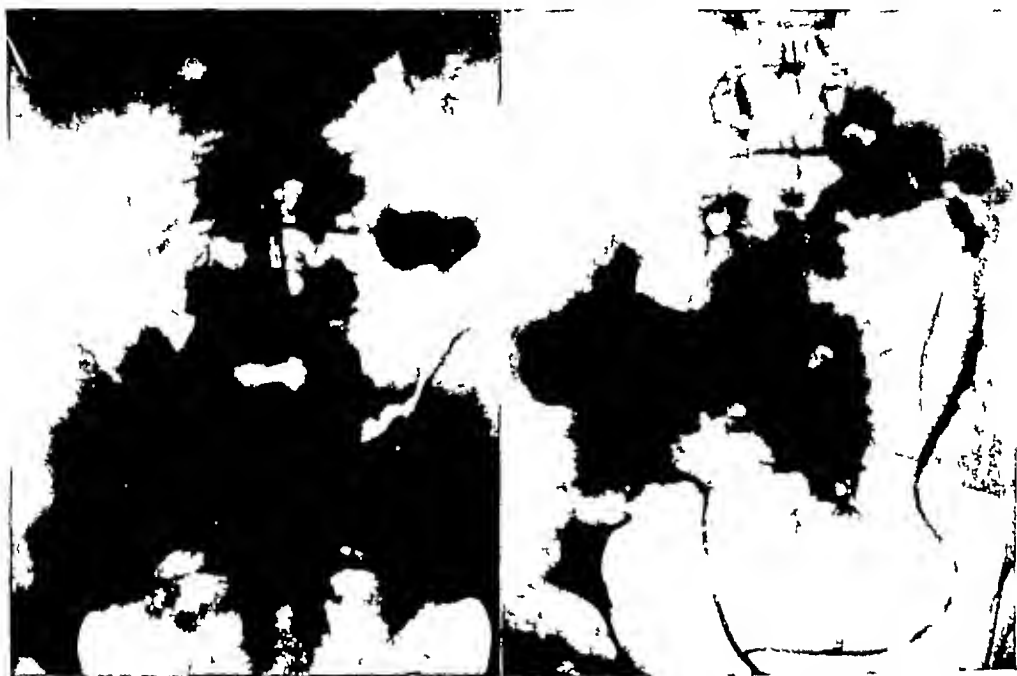


FIG 417—Horseshoe kidney with bilateral calculi The illustration on the left shows a single calculus in right half of a horseshoe kidney and two overlapping calculi in the left half Note level of the bilateral shadows opposite fourth lumbar vertebra The illustration on the right is a bilateral pyelogram of same case Note marked ectasis of pelves and calices, as well as difference in level of the two halves and their almost horizontal position Calculi were removed by pyelotomy through low iliac extraperitoneal incisions from both halves

Pathologic Changes

We have found 250 reports of operations on horseshoe kidneys In 21 of these cases, the two halves and isthmus were normal but they were operated because of a syndrome, termed the Rovsing, which will be discussed later In the remaining 229 cases, the pathologic changes which served as operative indications, were in the order of their frequency, nephrolithiasis, hydro- and pyonephrosis, tuberculosis, neoplasms and solitary cysts, ureterolithiasis, injury, acute nephritis, ureteral stricture and perinephritic abscess Of these, nephrolithiasis formed by far the most frequent indication for operative procedures

Symptoms

From the clinical standpoint, cases of horseshoe kidney can be divided into two groups

- 1 The structure as a whole is normal but gives rise to the Rovsing syndrome
 - 2 Those in which pathologic changes exist in the horseshoe kidney itself
- We will take these up in the order named

1 ROVSING SYNDROME GROUP This syndrome was first described by Rovsing (Copenhagen) and includes symptoms which have been ascribed to pressure of the isthmus upon the abdominal nerves and vessels in contact with its posterior surface. The patient complains of pain in the upper abdomen, most marked on changing from the supine to the sitting up position. Often they are especially noticeable when standing or sitting. In a certain number of cases, the patients lean forward in walking to create an artificial lordosis and relieve the

FIG. 418

pressure of the isthmus. It is frequently impossible for the patient to bend backward without an exacerbation of the pain or this may occur when trying to lift a heavy box, etc. In some cases the pain is worse after eating and in a few patients,

FIG. 419

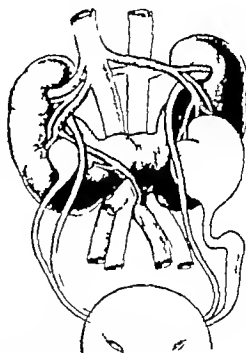
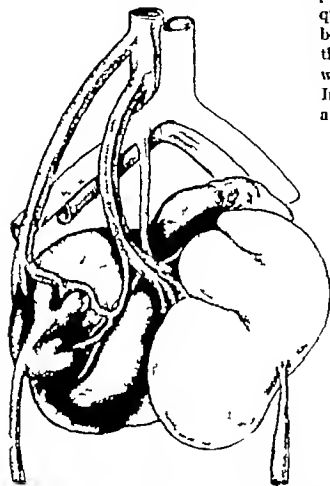


FIG. 418—Typical "cake kidney" located in true pelvis. This anomaly (see text) is the result of complete fusion along their medial borders of the two halves of a horseshoe kidney (Heimer's case).
FIG. 419—Zinner's case of combination of horseshoe and double kidney. Note two ureters and two renal pelvises for each half.

crises similar to those seen in tabes, with severe epigastric pain and vomiting have been reported. Twenty-one cases have been reported in which complete relief of the Rovsing syndrome followed operation. In 20 of the 21 only division of the isthmus, a procedure termed symphysiotomy, was done while in one case, a nephropexy was added.

2 THOSE IN WHICH THE SYMPTOMS ARE DUE TO PATHOLOGIC CONDITIONS IN THE HORSESHOE KIDNEY ITSELF As in the case of other renal anomalies there is no single or group of symptoms which is indicative of pathologic changes in a horseshoe kidney as distinguished from those in kidneys not presenting any anomalies. The recognition of the existence of this anomaly is only possible by urological methods of diagnosis.

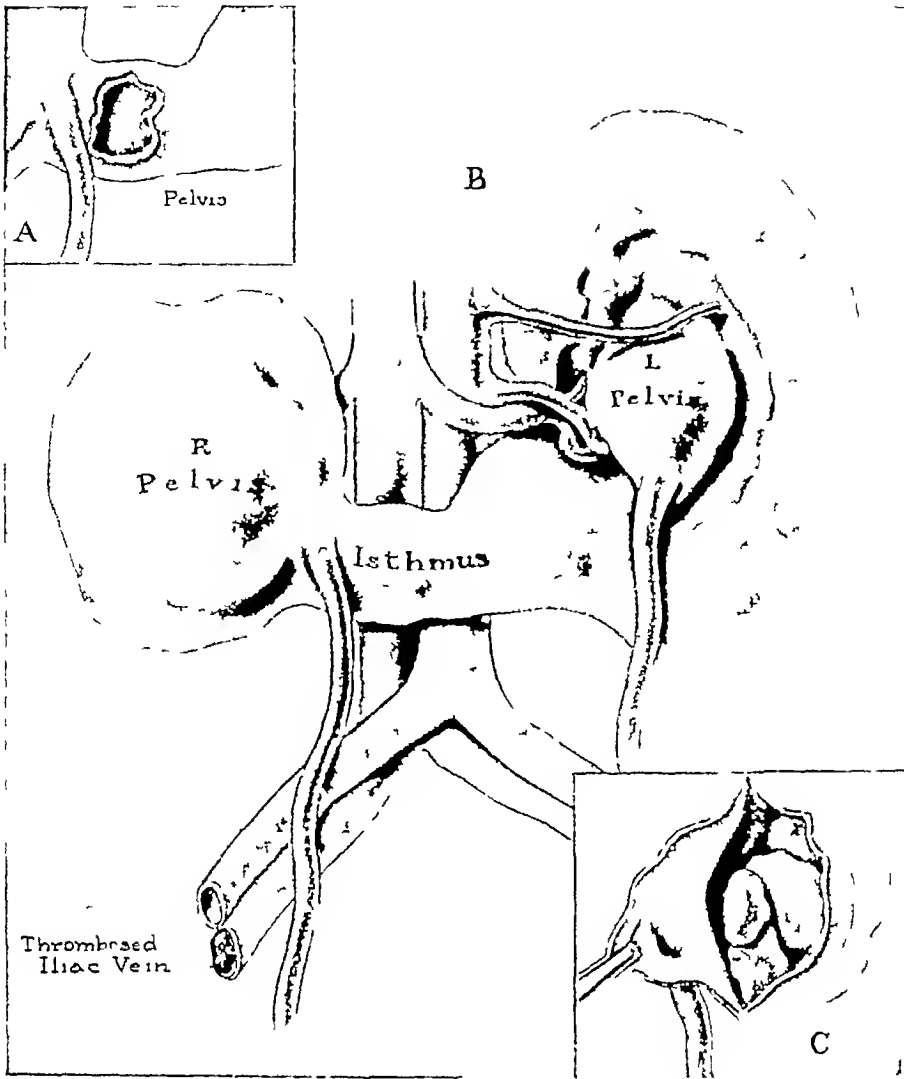


FIG 420—Necropsy findings in case of horseshoe kidney, six months after drainage of right hydronephrotic half and removal of four calculi from pelvis of left half

- A Note calyx in right half of isthmus
 - B Entire specimen, showing greatly dilated pelvis of right half which was pyonephrotic and also showing the dilated ventrally located pelvis of left half
 - C Multiple recurrent calculi of left half, due to high ureteral insertion
- This is from same patient shown in Fig 413

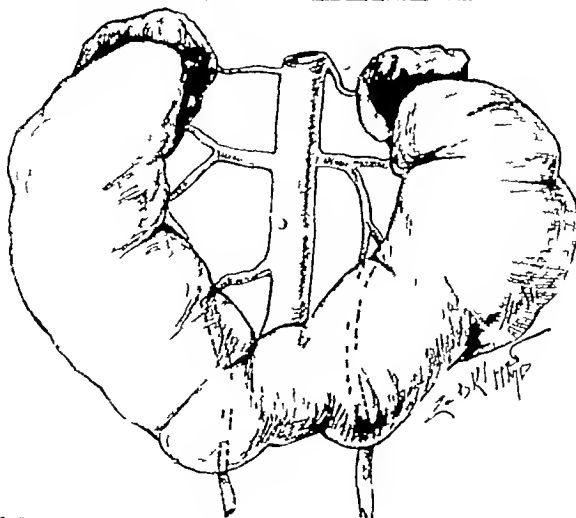


FIG 421—Horseshoe kidney with ureters behind isthmus (Rush Medical College Museum)

Diagnosis.

PALPATION This method alone was successful in 9 cases, chiefly in the period before modern diagnostic methods were available.

PLAIN RADIOGRAPHY In a few cases especially in thin patients, the isthmus and less often the halves are visible on plain films. Of more value is finding calculous shadows in close proximity to the spine (Fig 423) but if one half is in the location of the normal kidney such a close relation of the shadow is out of the question. We have recently encountered a calculous pyonephrosis in which some of the shadows were very near the spine, yet no horseshoe anomaly existed. The presence of shadows on both sides at the same level but much more caudad, should suggest bilateral nephrolithiasis in a horseshoe kidney (Fig 417). This anomaly

FIG. 422

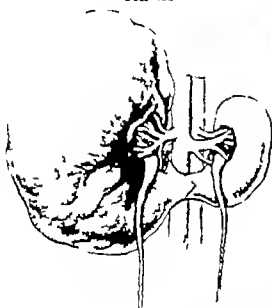


FIG. 423



FIG 422—Hydronephrosis of right half of horseshoe kidney. The dotted line indicates point where isthmus was divided (Karewski's case)

FIG 423—Typical location of a calculous shadow close to median line in horseshoe kidney. This can only occur when the corresponding half lies close to median line, which is not always the case.

must also be thought of if the shadows are at different levels, as occurs if the horseshoe kidney is asymmetric (Fig 411)

OPAQUE URETERAL CATHETERS This method is rarely employed alone, at present, but marked asymmetry in the course taken by one or both catheters (Fig 415) should make one think of the existence of a horseshoe kidney

UROGRAPHY Excretory urography has been employed with success in the diagnosis of the presence of a horseshoe kidney but until recently the majority of preoperative diagnoses not only of the presence of this anomaly but also of any associated pathologic conditions have been made by the ascending (retrograde) method. The chief features of diagnostic value are the following

(a) The pelves are lower and nearer the spine (Fig 414)

(b) One pelvis may be close to the spine and the other at the normal distance from the spine (Fig 416)

(c) One pelvis or a major calyx may lie directly over the spine (Fig 415)

(d) One or more calices of the respective halves (Fig 415) are directed mesially, i e , toward the spine

Treatment

This depends upon whether the Rovsing syndrome is present or the symptoms are due to pathologic changes in one or both halves. In the former case, symphysiotomy (division of the isthmus) has appeared to give relief. If the clinical picture is the result of any of the pathologic conditions mentioned above as having been most frequently reported, the treatment does not differ, except from the standpoint of operative technic, from that of similar conditions in kidneys in which no such anomaly complicates the question of treatment. In 250 operated cases of horseshoe kidney, primary heminephrectomy (removal of one half) was done in 117, pyelotomy or nephrotomy in 70, secondary heminephrectomy in 13

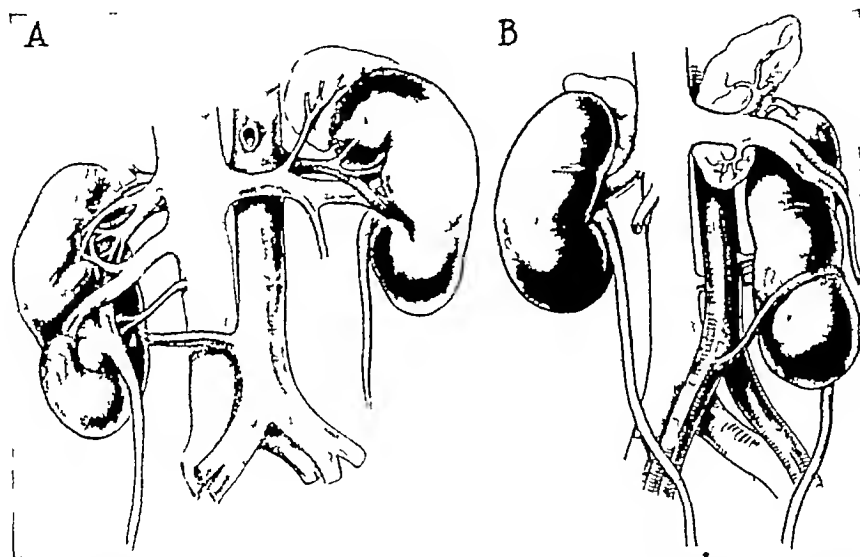


FIG 424—A Papin's case of faulty rotation of right kidney. Note pelvis on ventral surface. B Mouchet's case of faulty rotation with pelvis facing posteriorly.

Combined procedures were employed, such as pyelotomy followed by symphysiotomy and nephropexy in 17 and pyeloplasties or ureterolysis in 3. In 9 cases, various procedures were employed in injuries of horseshoe kidneys.

ANOMALIES OF ROTATION

We have seen (Chapter 1) that the hilum and with it, the renal pelvis, faces ventrally in the embryo. During its ascent to its permanent postfetal position, the organ undergoes a rotation on its long axis in such a manner (Fig 19) as to cause the pelvis to face mesially, i e , toward the spine. If this fails to occur, we find all degrees of faulty rotation (renal torsion) from a complete ventral (A of Fig 424) to a complete dorsal position (B of Fig 424) of the renal pelvis. Excessive rotation so that the pelvis faces outward (laterally) is very rare but may occur with (Fig 405) or without (Fig 408) the form of unilateral fusion termed crossed ectopia. Faulty rotation is also quite common in both horseshoe and double kidney, as well as in the type of ectopia, referred to as ordinary (see above).

Clinical aspects of faulty rotation

The pre-operative recognition of this anomaly, is of importance chiefly from the standpoint of operative procedures. If pyelotomy or nephrotomy (see Chapter

53) be contemplated much unnecessary manipulation and perhaps bleeding from anomalous vessels, is saved if one knows in advance that the pelvis is possibly either on the ventral or dorsal aspect (Fig 424) This information can be best obtained through ureteropyelography This reveals the presence of calices which are either directed toward the midline i.e. mesially (Fig 425), ventrally or both If one keeps in mind such a possible faulty rotation (renal torsion), it will be far easier to interpret many puzzling pyelograms (Fig 425) They also serve as an important link in the chain of preoperative diagnosis of such anomalies as ordinary and crossed ectopia double and horseshoe kidney in all of which faulty rotation is almost the rule

REDUPLICATION OF THE PELVES AND URETERS (DOUBLE KIDNEY)

Under normal conditions there is a single ureter and renal pelvis for each kidney in the embryo We have seen (Chapter 1) how the permanent ureter arises as a bud from the wolffian duct (Fig 3) to enter the metanephros where it divides into major and minor calices

FIG. 425



FIG. 425—Urogram of left kidney showing excessive rotation during embryonic life so that calices are directed medially

FIG. 426—Complete unilateral reduplication of the ureters and renal pelvis. Note rudimentary character of upper pelvis.



after expanding to form the renal pelvis Now under abnormal conditions one of two anomalies may develop Either a second ureter may arise as a bud from the wolffian duct (Fig 3) and enter the metanephros and divide just as a single normal ureter does or instead of two there may be three ureters. Under these conditions there are three ureteral orifices in the bladder (Fig 430) but one of the three corresponding ureters ends blindly

Instead of a separate bud to form a second ureter as just described, one can visualize how a single ureter can divide before it enters the metanephros, the level at which such a bifurcation occurs, varying from just after its origin from the wolffian duct, to a point just outside of the kidney itself. Inasmuch as the pathologic changes which give rise to clinical pictures in the two ureters, are overshadowed in importance by those developing in the corresponding halves of the kidney, the term double kidney is preferable, to reduplication of the ureters and renal pelves. It is understood that there is always a reduplication, as stated.

FIG 427



FIG 428

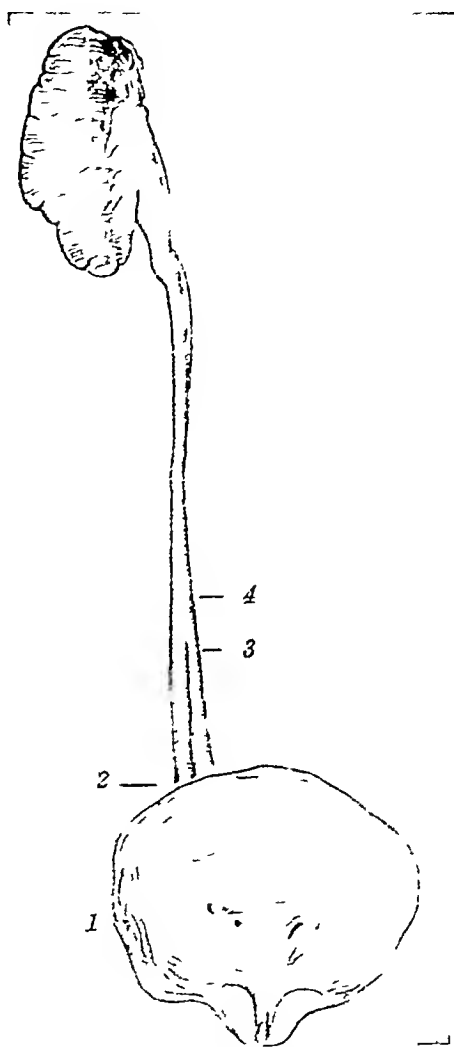


FIG 427—Complete bilateral reduplication of both ureters and renal pelves (bilateral double kidney) Cook County Hospital case. Note rudimentary upper pelves on both sides.

FIG 428—Case of ureter bifidus caudalis reported by Kreuzbauer (Zeit Urol Chir, 1927, 23:369). 1 Bladder showing two right and one left ureteral orifices, 2 The two right ureters united at about the pelvic brim at level indicated by 3, to form a single ureter (4). Courtesy of Dr F. H. Kreuzbauer.

Unilateral Double Kidney or Complete Reduplication There are two ureteral orifices on the corresponding side of the bladder (Fig 132), two ureters completely separated throughout their course and two separate renal pelves (Figs 426 and 429) which rarely communicate. The kidney may show both externally and on section, a division (Fig 433) or line of demarcation between the two halves or there may be no such external (or on section) separation (Fig 432) of the parenchyma of the two halves.

Bilateral double kidney or complete reduplication (Fig 427) Same as preceding, but more or less symmetrical findings on the opposite side of body, as well.

Unilateral incomplete reduplication (Fig 431) There is a single ureteral orifice but the ureter divides at varying levels to form two separate ureters and renal pelvis which enter their respective halves of the double kidney.

The demarcation between the two halves of the kidney or absence of it is as given under unilateral complete reduplication above.

Bilateral Incomplete reduplication. This occurs less often than the three preceding forms and only differs from the third of these by its bilateral character.

A case of ureter bifidus caudalis was found at necropsy by Kreuzbauer (Zelt Urol Chir 1927 23 369). The single ureter corresponding to a single renal pelvis divided just before entering the bladder wall each ureter ending separately in the bladder (Fig 428).

FIG. 429



Incidence of Double Kidney

In 86,514 necropsy reports by various authors this anomaly was found 460 times or about 1 in 183 necropsies according to Herman (Zelt Urol Chir 1930 30 361).

FIG. 430

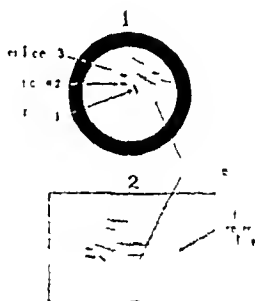


FIG. 430—Complete unilateral reduplication of the ureter and renal pelvis (C. L. Cowie Hospital case).

FIG. 431—Cystoscopic appearance in case of three ureteral orifices (kin J. L. and D. R. H. H. Lee). The case was reported by La and Hentze (JAMA 1931). One of the orifices entered the bladder; the other three entered the respective halves of the kidney.

Clinically the anomaly has been observed on one side in 50 per cent and on both sides in 50 per cent of 119 cases. The reduplication of the ureter was incomplete in 70 per cent and complete in 30 per cent of the unilateral cases. The opposite is true of the bilateral cases of double kidney, viz. 50 per cent were complete and 50 per cent incomplete reduplication.

Anatomical Considerations

1. LOCATION OF SEPARATE RENAL SIZES OF THE TWO HALVES

(a) There may be no demarcation either externally or internally of the two halves.

(b) A groove or furrow (Fig 433) of variable depth, is an external evidence of demarcation and there is a similar condition on section (Fig 433)

THE UPPER HALF FORMS ABOUT ONE-THIRD AND THE LOWER, THE REMAINING TWO-THIRDS OF THE MASS, but either one may be so poorly developed (hypoplasia), as to be a mere appendage to the remaining half

ASSOCIATION WITH OTHER RENAL ANOMALIES, location, etc Several cases have been reported of a combination of horseshoe kidney with reduplication of the ureters and pelves The presence of a hypoplastic kidney on one side and of a double one on the opposite, has also been noted Genital anomalies are comparatively rare (see later)

RELATION OF URETERS AND URETERAL ORIFICES As a rule, each pelvis ends in a ureter, but there may be only a number of calices, in place of a pelvis Both ureters may lie in the same sheath or they may be separate throughout their course One must distinguish high division (Fig 21) of a single ureter ending in a single (Fig 21) or bifid pelvis from reduplication of the ureters, in which each ends in a separate pelvis The two ureters may unite at any level, from a point just distal to the renal hilum, to a point within the bladder wall itself In four cases, a communication was found between the two ureters

Although the two ureters may cross several times, the final relation is such that the ureteral orifice of the upper half of a double kidney almost invariably is more mesial and caudal, i e, nearer the vesical neck, than that leading to the lower half, which lies more lateral (outward) and cephalad (higher) The orifices may either lie above each other or at the same level (Fig 143)

Lau and Henline (Jour Amer Med Ass'n 1931, 96, 587) reported a case in which three ureteral orifices (Fig 430) were found on the right side of the bladder Further study showed that one of the three corresponding ureters ended blindly about 11 cm from the bladder The other two corresponded to the two pelves of a double kidney A similar observation was reported by Chwalla (Zeit Urol Chir 1935, 41, 224), the three ureters being also on the right side and the ureter corresponding to one of them ending blindly opposite the body of the fourth lumbar vertebra Chwalla quotes Suhrig who noted one case of triple ureters in 38 double kidneys found at necropsy Ectopic ending of the ureters in this type of anomaly has been discussed in the chapter on Anomalies of the ureters It may involve the ureter of one-half, most often the upper, of the double kidney of one side, the ureter of one-half of both double kidneys when the anomaly is bilateral or the ureter of both halves of a unilateral double kidney may end ectopically (see Chap 29)

Communication of Renal Pelves Braasch was the first to call attention to the occurrence of this feature of double kidneys and a similar case has been reported by Emiliani (Ar Ital Urol 1932, 9, 340)

Clinical Aspects

SYMPTOMS AND DIAGNOSIS As pointed out, there is nothing in the clinical pictures presented by pathologic conditions in this type of anomalies, which can be termed characteristic The only group of cases in which one should always look for the existence of a double kidney are those where an incontinence or pyuria persists in spite of efforts to find their source in the normally developed upper

urinary tract. The search for ectopically ending ureters in relation to the occurrence of incontinence or pyuria or both has been described in Chap 29

In the 213 operated cases of double kidney which we have found in the literature the indications were the same as in the other renal anomalies previously described. Nephro- and ureterolithiasis head the list as to frequency, next come hydronephrosis, acute and chronic pyelonephritis and tuberculosis. These 213 cases do not include the cases in which removal of one half (heminephrectomy) or the



FIG. 431.—Presence of a rudimentary pelvis as shown in A should lead to suspicion of presence of a double kidney or a hypoplasia. B sh ws how the diagnosis was made, as first suggested by Mertz. There was only one ureteral orifice but catheter was completely withdrawn after injection of opaque medium (Cook County Hospital case)

entire double kidney was done because of ectopic ending of the respective ureters for incontinence

The percentage of cases in which a correct preoperative diagnosis was made of a pathologic condition involving a uni or bilateral double kidney was very high.

THE SPECIFIC DIAGNOSIS OF UNI OR BILATERAL DOUBLE KIDNEY, is based upon the following in addition to the symptoms pointing to some condition of the kidneys

(a) THE PRESENCE OF TWO URETERAL ORIFICES (Fig 132) on one or both sides of the bladder or of one of these nearer the neck

(b) THE PRESENCE OF AN ECTOPIC (EXTRAVESICAL) URETERAL OPENING (see Chapter 29)

(c) The use of opaque ureteral catheters and of urography (Figs 426, 427, 429 and 431)

If only one ureteral orifice is present on the double kidney as occurs in incomplete reduplication (Fig 431) the diagnosis can only be made by the use of opaque catheters and urography. It is advisable to withdraw the catheters completely, as a routine procedure after injecting the opaque medium in order to avoid overlooking such an incomplete reduplication (Fig 431)

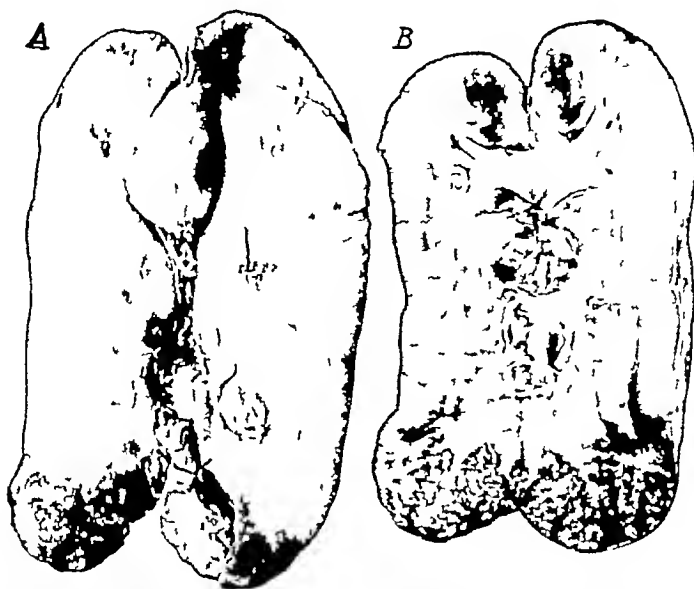


FIG 432—Double kidney without any demarcation between the two halves. Note pyelonephritis with multiple abscesses involving lower pole. The two pelves are seen in B.

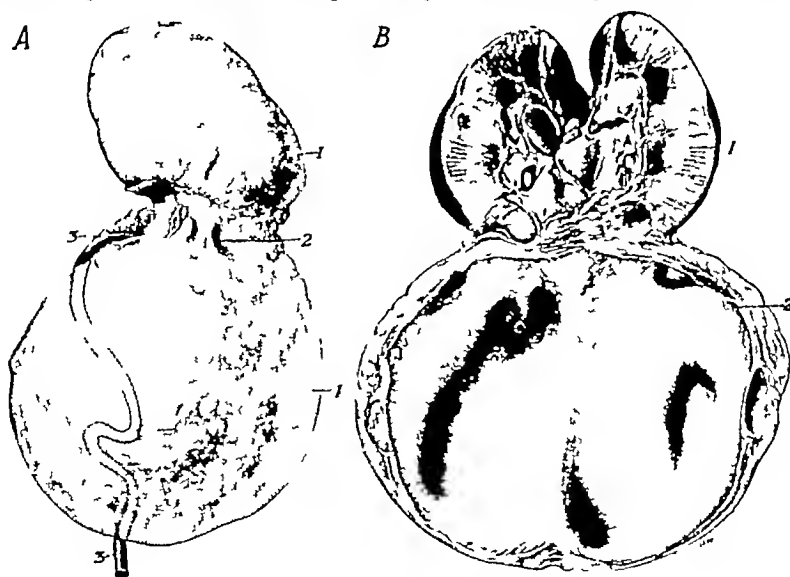


FIG 433—A Exterior of double kidney with hydronephrosis of lower half due to faulty origin of ureter.

B Sectional view of same kidney, showing deep groove between the two halves.

In such a kidney, heminephrectomy does not present as many technical obstacles as where there is no line of demarcation between the two halves (Fig 432).

Treatment

The indications for nonoperative treatment of certain pathologic conditions, like acute and chronic pyelonephritis, are practically the same for this anomaly as

for the same conditions in a kidney with a single renal pelvis and ureter. Of the 213 operated cases which we have collected, total nephrectomy (both halves removed) was done in 126 as a primary operation and in 8 as a secondary (following pyelotomy etc.) one. Removal of only the upper or lower half (heminephrectomy) was the type of intervention in 61 and pyelotomy or nephrotomy in 18 cases. A case reported by one of us was the first in which a bilateral heminephrectomy was done.

ANOMALIES OF THE RENAL PELVIS OTHER THAN DOUBLE KIDNEY

True anomalies of the renal pelvis can be divided into two groups (a) congenital hydronephrosis and (b) extrarenal pelvis and calices.

Congenital Hydronephrosis. In spite of a few (Gruber) writers who hold the opposite view we believe that a dilatation of the ureters (see Chapter 29) and of the renal pelvis can exist without a demonstrable obstruction (Fig. 347). English was the first to call attention to such a condition and a number of cases have been reported since that time. In other words such a dilatation can be found

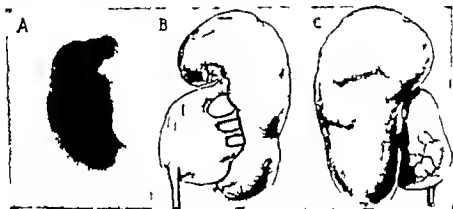


FIG. 434.—Case of hydronephrosis in kidney with extrarenal pelvis.

A. Pyelogram before operation.

B. Specimen (front view) showing extrarenal pelvis and calices, as well as high origin of ureter.

C. Posterior view.

without (a) anomalies of the pelvis itself or a faulty ureteral origin (b) valves strictures torsion diverticula or faulty (extravesical) ureteral ending and (c) contractures of the vesical neck valves etc. in the urethra or phimosis.

The underlying condition in these cases of congenital dilatation of the renal pelvis (and usually of the ureters) is either a defective development of the musculature or some disturbance in innervation. Clinically the cases can be divided into (a) those which are symptomless and the condition is found by accident, (b) those with pyuria finally and (c) those in which there are symptoms of a generalized infection without localizing signs. The last named type is especially common in infants and children.

Extrarenal Pelvis and Calices. This is an interesting anomaly and may assume much clinical importance. It may be found in association with such anomalies as ordinary and crossed ectopia, horseshoe and double kidney solitary and hypoplastic kidneys. It may be found in an otherwise normal kidney or in one which is the seat of faulty rotation and finally in cases of congenital hydronephrosis.

The pyelogram reveals a ureter dividing either into a number of calices or the renal pelvis and its calices seem well clear of that of the kidney (Fig 434)

ANOMALIES OF THE VESSELS

These are considered separately in Chap 34

UNCLASSIFIED ANOMALIES OF THE KIDNEY AND URETERS

Under this heading must be placed the cases reported by Hepburn and Braasch. We are at a loss to explain the findings from the embryologic viewpoint.

In both cases there was a low bifurcation of the ureter. One of these branches lead to the right and the other to the opposite kidney. There was a complete absence of the lowermost portion of the ureter and vesical orifice on the opposite side.



FIG 435—Bicornuate uterus in a case of hydronephrosis of a congenital solitary kidney located in midline of body

ACCOMPANYING (CONCOMITANT) ANOMALIES

The principal groups which accompany renal or ureteral anomalies are as follows

1 Urinary defects such as exstrophy (Fig 301), congenital dilatation and diverticula of the bladder. Congenital stricture and valve formation in the posterior urethra also should be included under this heading.

2 Defects of the Genital Tract in the Male. Phimosis, hypospadias, nondescent of the testis, absence of development of the testis, prostate and seminal vesicle of one side (in solitary kidney).

3 Defects of the female genital tract (Figs 435 and 436). We will mention briefly the more important defects of the last two groups.

IN THE FEMALE 1 In the solitary kidney. In the female, Kermauner's classification is the simplest, and is employed by Eismayer³ who studied the reports of 122 cases, to which we have been able to add six, making a total of 128 cases grouped as follows

a Reduplication without system defects (major and minor). There are forty-one cases in this group including fourteen cases of bicornuate uterus (Fig 435), six of duplex uterus and vagina, nine of uterus bicornis duplex and similar⁴ anomalies.

b Reduplication with system defects (a) Rudimentary development of entire system of one side. This includes uterus unicornis (Fig 436) without twenty-seven cases) and uterus bicornis with rudimentary horn of one side (thirty cases).

Rudimentary development of system of both sides (twenty cases). Absence of or rudimentary uterus and vagina.

Same with partial duct defects. Tube and ovary absent on one side (ten cases).

³ Zeit Urol Chir, 1923, 11, 191

⁴ See any standard textbook on gynecology

IN THE MALE in association with solitary kidney the following have been found

- 1 Absence of the seminal vesicle alone on the agenesis side (three cases)
- 2 Same as above and also vas deferens (four cases)
- 3 Same as above and also absence of epididymis (one case)
- 4 Absence of seminal vesicle and ejaculatory duct (two cases)

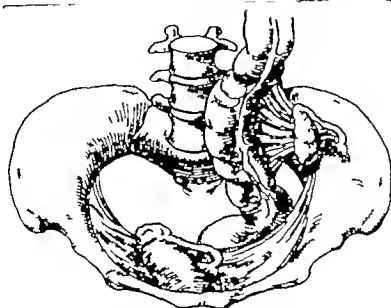


FIG. 436—Asymmetric development of internal genitalia in congenital solitary kidney. Note rudimentary left uterine horn with left ovary and tube over brim of pelvis.

- 5 Absence of above and also of vas deferens (two cases)
- 6 Absence of testis alone (two cases)
- 7 Absence of testis seminal vesicle and vas deferens (one case)
- 8 Absence of vesicle vas, ejaculatory duct testis and part or all of epididymis (three cases)

- 9 Ectopic ending of ureter in seminal vesicle (Fig 354) or ejaculatory duct

Anomalies of the female and male genitalia accompanying hypoplasia ordinary (simple) ectopia crossed ectopia horseshoe and double kidney are rarely found in comparison with those enumerated above as accompanying congenital solitary kidney. They do not differ however from the defects observed in connection with agenesis of one kidney (solitary).

CHAPTER 33

INJURIES OF THE KIDNEY

SUBPARIETAL INJURIES

MECHANISM
CHANGES IN AND AROUND THE KIDNEY
COMPLICATIONS
SEQUELS
CLINICAL PICTURES
DIAGNOSIS
TREATMENT

EXTERNAL (PENETRATING) WOUNDS

CLINICAL PICTURES AND DIAGNOSIS
TREATMENT
SPONTANEOUS RUPTURE OF THE KIDNEY
INJURIES TO THE RENAL PELVIS

Injuries of the kidney are best divided as follows

- 1 Subcutaneous, also termed subparietal or nonpenetrating, in which there is no external evidence of injury, except at times, an ecchymosis of the skin over the iliocostal space or corresponding upper abdominal quadrant
- 2 Penetrating injuries, where there is an external wound of entrance over the kidney region or in close proximity to it
- 3 Spontaneous rupture of the kidney,¹ and
- 4 Injuries of the kidney following ascending urography² are occasionally seen

Let us consider these separately

SUBPARIETAL OR NONPENETRATING INJURIES

These form the majority of the cases seen clinically. In a personal series of thirty injuries of the kidney, twenty-seven were of the subparietal variety. As to sex, such injuries are most frequently seen in males, there being twenty-one males to nine females in our series. As to sides, there was no difference in our thirty cases, in none was a bilateral injury of the kidneys found.

MECHANISM OF SUBPARIETAL INJURIES

The kidney can be injured in one of three ways

(a) By force exerted (A of Fig 437) either from the front, side, or behind, for example, a blow, fall or a crushing force. This may act directly through the abdominal wall (A of Fig 437) or cause the lower ribs to be forced against the resistant spine. This mode of injury is the most frequent one.

(b) The Mechanism of Injury May Be Indirect. This occurs when the kidney is injured after falls on the feet or buttocks (B of Fig 437). Whether the kidney is injured by its being thrown against the resistant vertebral column or as the result of reflex contraction of the diaphragm and posterior abdominal muscles (including the psoas), is not clear. This mode of injury is rare. While walking downstairs, one of our patients stepped heavily on one heel and then felt a "jarring" on the left side. This was followed by a hematuria and left lumbar pain which persisted for ten days and then cleared up. This mode of injury is comparatively rare.

(c) Injury by Muscular Action. This mode of injury is also rare and can occur as the result of a sudden contraction of the diaphragm or of the

¹ These are also discussed in relation to nephrolithiasis in Chapter 42

² These were taken up in Chapter 7

abdominal muscles, for example after lifting a heavy weight or in abrupt flexion of the body

It has been shown experimentally that it is practically impossible to rupture the kidney post mortem. The kidney is distended with blood at the time of injury and the mechanism is thought to be that of increased hydraulic pressure causing a sudden bursting of the kidney. The injury is really more than a tear. Fracture of the kidney is the term more appropriately applied to some cases. Tears of the kidney are nearly always irregularly transverse or oblique rarely longitudinal, the sudden increased tension tearing the kidney at its weakest point

CHANGES IN AND AROUND THE KIDNEY

Küster was the first to offer the hydraulic theory in order to explain injuries of the kidney. Although this will not be applicable to tearing of the vessels of

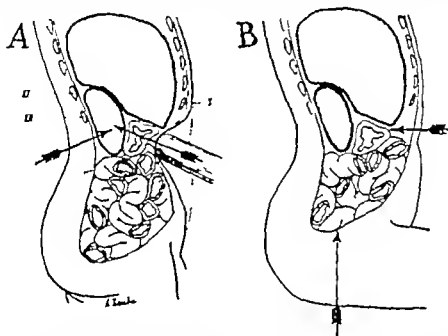


FIG. 437.—Modes of injury of kidney by nonpenetrating (subparietal) force (Paplin.)

A By direct force exerted either from behind or in front.

B By indirect force after fall on buttocks or sudden contraction of abdominal muscles

the renal pedicle or of the ureter. It serves to clear up the manner in which at least injuries of the kidney proper occur. The kidney when filled with blood and subjected to compression will tear as does the skull or brain at the point where its elasticity fails to resist the compressing force. The hydraulic theory of Küster although it accounts for the majority of injuries of the parenchyma of the kidney does not explain (a) a large hematoma beneath the true capsule (b) a complete division of the ureter or renal vessels and (c) a complete separation of the upper or lower poles. The mechanism of injury as reported in experimental and clinical studies is that of indirect force transmitted to the kidney somewhat similar to that of contre-coup in fractures of the skull. The fixation of the diaphragm at the time of injury, the pressure upon and resultant fracture of the ribs and pressure against the spine are factors in the production of the rupture of the kidney.

The presence of the liver on the right side limiting the mobility of the

kidney, is considered a factor in the usually reported greater frequency of right-sided injury. In none of this series was the injury bilateral. Injuries of the kidney are relatively infrequent, a review of the records at the Cook County Hospital (Chicago) showed its incidence as one in 3000 admissions.

The experimental studies of renal injuries by Stirling and Lands³ are of interest. Kidneys of dogs and cats were exposed and subjected to a direct blow. An important observation in these experiments is the protective function of the fibrous capsule of the kidney. The fatty and fibrous capsules absorb the blow to a large degree and thus prevent extensive damage to the kidney. The fibrous capsule is torn only following severe injuries. When the capsule had been torn or the kidney previously decapsulated, severe damage such as complete tears and pulpification of the kidney resulted from direct blows.

The following classification of varying degrees of subcutaneous injuries of the kidney compares favorably with the experimental findings of Stirling and Lands.

(a) **Those of the True Capsule Alone, or of This and the Perinephritic Fat.** A hematoma may form beneath the true or fibrous capsule and either be absorbed or end in a collection of fluid beneath the capsule (D of Fig 438 and A of Fig 440). The capsule may be torn and blood escape into the perinephric fat or there may be hemorrhage into the fat independent of capsular injury. As a rule such a perirenal hematoma is not very extensive and is rapidly absorbed. It may, however, become organized and a perirenal sclerosis (Chapter 40) result, or a collection of fluid replace the clot. To this latter cystic condition, the term pseudo-hydronephrosis has been applied (C of Fig 438 and A of Fig 440).

(b) **Contusions of the Parenchyma.** In this form of injury, there is hemorrhage into the cortex and medulla without any visible tears of the fibrous capsule or parenchyma. These cases can present all of the symptoms of renal injury (see later), but in a mild form. Only microscopic examination will, in some cases, determine the presence of localized or more diffuse hemorrhage into the glomeruli and intertubular structures.

(c) **Superficial tears of the parenchyma with or without accompanying capsular and perinephric injury.** These tears extend inwards a variable distance and may be complicated by a localized subcapsular (F of Fig 438) or a more widespread perirenal hematoma (C and D of Fig 438). Such shallow tears do not communicate with the pelvis. They may radiate from the hilum (F and C of Fig 438) or be transverse, oblique or irregular (A of Fig 438 and A of Fig 440).

(d) **Complete or Deep Tears.** These usually radiate (B and D of Fig 438) from the pelvis and calices, so that urine mixed with blood can escape into the perirenal tissues, lifting up the peritoneum. The extravasated blood and urine may also gravitate along the periureteral sheath to the true pelvis, scrotum, labiae and abdominal wall.

HEMATOGENOUS INFECTION OF THE EXTRAVASATED BLOOD AND URINE can occur, so that extensive perinephritic suppuration follows, with much danger of secondary bleeding. If infection does not take place, the urine and blood can be absorbed. This must frequently occur, as can be judged after inspection of specimens of injured kidneys, in which healing has occurred.

³ W. Calhoun Stirling & A. M. Lands, "An Experimental Study of Injuries of the Kidney," Jour. Urol., 1937, 37, 466.

In the case shown in Fig 439 the kidney was almost completely divided. The patient was a boy ten years of age who was operated by the late Dr L. A.

FIG. 438

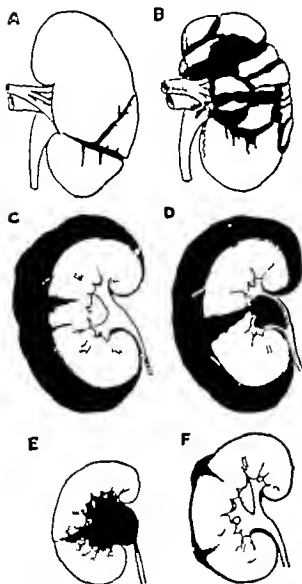


FIG. 439



FIG. 439.—Kidney removed because of extensive laceration with severe bleeding into peritoneal cavity in boy of ten. (Courtesy of Dr L. A. Greensfelder)

FIG. 440

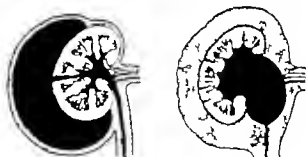


FIG. 438.—Diagrammatic representation (after Papin) of the various degrees of injury of kidney

- A. Flimsy rupture involving only lower pole.
- B. Almost complete destruction of kidney involving large vessels at pedicle (See also Fig. 445)
- C. Small laceration of cortex but large perinephritic hematoma.
- D. Same as C but extending into renal pelvis.
- E. Marked accumulation of blood in pelvis from relatively slight injury of parenchyma.
- F. Subcapsular tears with localized hematoma.

FIG. 440.—A. Communication of a perirenal hematoma with a rupture of kidney extending into pelvis.

B. Large hematomatous with perirenal sclerolipomatosis and stricture (traumatic) of ureter (Courtesy of Dr E. Papin.)

Greensfelder because of symptoms which suggested a rupture of a hollow viscus. Upon opening the abdomen the peritoneal cavity was found to contain a large amount of clotted and liquid blood. Further exploration revealed a tear in the

peritoneum over a severely injured right kidney from which the blood was escaping into the peritoneal cavity. The ruptured kidney (Fig 439) was removed transperitoneally, followed by recovery.

(e) **Complete Division of the Vessels, Ureter, etc** These are usually associated with injuries such as were described in the preceding degree of laceration of the parenchyma. In rare instances, there may be a rupture of all of the blood vessels or of the renal artery or vein alone. The ureter may be torn across alone or this be associated with similar injury of the blood vessels, with or without (rare) lacerations of the parenchyma. When the ureter is severed, neither urine nor accumulated blood in the renal pelvis (E of Fig 438) can find its way into the bladder. We shall refer later, under Diagnosis, to the occurrence of reflex anuria in some of these cases. The end result of such a ureteral division is not infrequently the development of a true hydronephrosis (B of Fig 440). The effects of division of the large renal vessels will be taken up again under clinical pictures.

COMPLICATIONS

(a) **Concomitant Injury of the Bony Structures** This most commonly involves the ribs. Later (see Diagnosis), attention will be directed to the necessity of keeping in mind an associated injury of the solid viscera (liver, spleen and kidney), in every case of fracture of the last three or four ribs.

(b) **Concomitant injury of the peritoneum overlying the kidney** A tear of the parietal peritoneum over the anterior surface (Fig 17) is most apt to occur in conjunction with an injury (Fig 439) of the kidney in younger individuals, but it can occur at any period of life. It is not a frequent complication. When it exists, the blood from the ruptured kidney or its main vessels, escapes into the peritoneal cavity and the resulting hemorrhage causes death within a few hours.

(c) **Injury of the Intraperitoneal Viscera, Diaphragm and Lungs** These are not at all infrequent and one should keep them in mind in every case of kidney injury.

As stated previously, when injuries of the associated viscera or renal vessels are extensive the patient succumbs rapidly before receiving medical aid, and these findings are usually seen postmortem.

SEQUELS OF KIDNEY INJURIES

These may be grouped as follows:

1 **Changes in the Parenchyma and Renal Pelvis (except hydronephrosis)** In all cases in which recovery takes place without operative intervention, the injured parenchyma is replaced by cicatricial tissue. This results in more or less obliteration of the major and minor calices and at times also the pelvis proper. These changes can be visualized clinically with the aid of both excretory and retrograde urography as shown in Figs 441 and 442. From the medicolegal standpoint it is important to keep such an objective method of diagnosis in mind, when associated with loss of function of the injured kidney. Chronic pyelonephritis may also be a sequel of kidney injury as the result of a low grade infection.

2 **Traumatic Hydronephrosis** This is the result of (a) more or less complete division of the ureter at or close to the ureteropelvic junction with subse-

quent stricture formation and hydronephrosis, or (b) there is such an intense periureteral inflammatory reaction following the injury that the ureter is compressed by cicatricial tissue and a hematonephrosis (B of Fig 440) results. Later the blood is absorbed and a hydronephrosis develops. Evidence of the latter may not present until many years after the injury.

In a case recently reported by one of us (Jour Amer Med. Ass'n 1935 104, 1898) the patient had a hematuria of two weeks duration following the injury

FIG. 441



FIG. 442



FIG. 441—Urogram one year after injury of left kidney. Note filling defect of pelvis and dilated ends of major calyces of injured side owing to scar tissue simulating renal tumor.

FIG. 442—Marked urographic deformity one year after subparietal injury of right kidney. Note filling defect of lower major calyx and dilatation of upper calyces.

(fall on sidewalk). There was complete absence of symptoms for twenty years when the hematuria suddenly recurred. Urologic study revealed almost complete obliteration of the ureter at its junction with the renal pelvis on the injured side with an associated very marked hydronephrosis. Similar cases have been reported by others.

3 Perinephritic Changes These may consist (a) in the formation of a perirenal collection of fluid following resorption of the blood which has been extravasated around the kidney. The fluid may be found between the fibrous capsule and the kidney (A of Fig 440) or in the fatty capsule (Fig 17) or (b) there may be only a very marked fibrous perinephritis (B of Fig 440). In one of our cases operated a year after the injury on account of persistent pain the sclerotic perinephritic tissue had greatly compressed the kidney. The peritoneum

was so adherent to the perirenal tissues that mobilization of the kidney was only partially accomplished. In another case operated upon six weeks after the injury, the capsule was already almost 2 cm thick.

4 Urinary Fistula If spontaneous evacuation of infected extravasated urine takes place, a cutaneous fistula may persist owing to the presence of a minimal amount of secreting parenchyma. In one of our cases, we were obliged to operate because of such a urinary fistula and only found a narrow rim of intact parenchyma attached to a renal pelvis whose outlet had been obliterated.

CLINICAL PICTURES

Many of the cases give a history of having stumbled and fallen so that the right or left side of the abdomen came in contact with the ground. The patient then fainted and within an hour, nausea and vomiting occurred, accompanied by pain and tenderness over the corresponding side. Two hours later a gross hematuria was noted which was still present on admission to the hospital. On examination of the abdomen, there was marked rigidity of the right or left upper quadrant and ilio-costal space. In some cases, abdominal distension was so marked, as the result of reflex paresis of the intestinal coils (Fig 750), that it was difficult to decide whether the kidney alone was injured or whether there had been a rupture of some intraperitoneal viscus. In some cases, the patients had fallen from a height and struck a sharp object, like a stone, fence, etc. The most common clinical pictures presented by kidney injuries are the following, grouped according to the outstanding symptom.

1 Hematuria This is present in about 90 per cent of all cases. Usually it is observed immediately after the injury but may be delayed if the ureter is blocked by a clot. Hematuria is the most prominent symptom and immediately directs attention to the urinary tract. The duration of the hematuria varies considerably. In two of our cases, it ceased within twenty-four hours. In four others, it persisted intermittently over a period of three to five weeks. The average duration in our series was five to six days. The urine was always grossly bloody at first, the hematuria clearing up gradually, but occasional clots persisting.

In cases of less severe injury (shallow tears or contusions) or when the ureter is severed, there may be a complete absence of hematuria or, as a rule, blood will be present only in microscopic amount. That there are exceptions is illustrated by one of our recent cases. There was a very severe hematuria for several days after the accident. This gradually decreased until the urine was clear. As soon, however, as any exertion was made, hematuria of moderately severe degree recurred over a period of five weeks. Operative exposure revealed only a few small clots around the kidney. There were no visible tears on the surface. In view of the persistence of the hematuria and moderate secondary anemia, nephrectomy was performed. There was an absence of naked eye changes but microscopically, one could see many areas of hemorrhage between the capillary tufts of the glomeruli and in the intertubular tissue. When one recalls the minimal changes found in cases of so-called "essential" hematuria as referred to in Chapter 44, it is not surprising to note the small amount of injury, possibly in the form of a concussion or contusion of the parenchyma, which will initiate bleeding from the kidney. Such cases are of constantly increasing interest from a medicolegal point of view.

In another of our cases, the hematuria did not appear until five weeks after the injury. The patient had slipped and injured his right side. He suffered some pain which cleared up in a few days, then went about doing his usual work. Four days before entering the hospital he noticed that his urine was slightly bloody. The hematuria subsided for forty-eight hours to appear again but in a more marked form. He came to the hospital greatly exsanguinated. Twenty-four hours later the hematuria had subsided with rest in bed. On the third day of his stay in the hospital hematuria suddenly reappeared in a much more severe form. His bladder became distended with blood clots which could be evacuated only through repeated irrigations through a metal catheter. These clots were long and worm like typical of ureteral clots. Shortly afterwards the patient was operated upon having received a blood transfusion and other measures to combat shock. At operation the kidney was found to be completely divided by a transverse tear extending down to the pedicle. The outer capsule was intact. The most likely explanation of this injury is that the patient had a slight tear at the time of injury five weeks previously and that this had produced only a small superficial hemorrhage. However the continued activity of the next five weeks together with jarring of automobile riding had completed the tear and only then did hematuria begin.

The degree of hematuria after an injury is in general in direct proportion to the extent of the injury provided of course that the ureter is not torn or occluded by a clot or there is an absence of secretion because of traumatic thrombosis of the renal vessels. Pisaní has reported an instance of the latter in which there was no hematuria. The latter in some slight injuries may be only microscopic, while in others it may be so profuse as constantly to fill the bladder with blood and to threaten life by its severity. Secondary hematuria, i.e. some time after the injury is not rare and is the result of erosion of vessels from infection. A marked decrease in the output of urine from both kidneys and even anuria, occur at times as the result of reflex inhibitory influence (see Chapter 47) of the injured upon the uninjured kidney.

2 Pain. This is rarely absent. In some cases it is very severe and often of a colicky character due to the passage of blood clots from the kidney to the bladder. The pain may be very severe if the ureter is blocked by a clot (E of Fig. 438) or is kinked. The continuance of pain should always lead to an examination for a traumatic hemato- or hydronephrosis (B of Fig. 440).

3 Tumor Formation. This is a prominent feature at times due to the extravasation of urine or blood (C and D of Fig. 438) or both around the kidney. A gradually increasing swelling accompanied by localized rigidity and tenderness over the ilio-costal space and corresponding upper abdominal quadrant is the local evidence of such an extravasation. Very often infection may occur and a perinephritic abscess develop so that operative interference should not be delayed in such cases. In the transcapsular form of injury in which the fatty capsule is also torn a hematoma may gradually develop which may become marked and present itself as a bulging mass in the loin. In some cases the hematoma instead of remaining localized may gravitate downward along the posterior peritoneum or along the ureteral sheath and appear in the pelvis or scrotum. Usually however the hematoma remains limited around the kidney and does not give rise to a bulging in the loin. In extensive injury there is an extravasation

of urine also, due to large tears in the calices and pelvis. In the less severe forms there is no urinary extravasation, the injured portion of the kidney ceasing temporarily to secrete urine. A marked oliguria, i.e., diminished urinary secretion, was noted in some of our cases the first two or three days after injury. Perinephritic abscess developed in four of our cases. The extravasation of urine and blood, which later became infected, produced the abscess. In two of the four cases, the rapid development of a perinephritic abscess was followed, after incision and drainage, by a urinary fistula due to extensive injury to the kidney and pelvis. Both of these cleared up within three to four months. In subcapsular injury, the bleeding usually subsides more rapidly as the result of the increased tension within the capsule. Neither urinary extravasation nor hematoma is present but the pain is often severe because of the increased intracapsular tension.

4 Peritoneal Irritation These symptoms may predominate in the clinical picture. They are most marked when blood escapes into the peritoneal cavity as the result of a tear in the peritoneum in front of the kidney. The emesis, abdominal distention and inability to pass flatus will, in some cases simulate an intra-peritoneal visceral injury. The patient, however, does not appear seriously ill, the pulse rate is increased but little and auscultation of the abdomen shows intestinal peristalsis still present. These peritoneal symptoms clear up in a few days. We recall such a case in which the accompanying hematuria pointed to the kidney, as the seat of the injury. The treatment was chiefly directed to the relief of the reflex intestinal paresis.

Extensive hemorrhage into the peritoneal cavity follows a much more rapid course and the clinical picture is that of an internal hemorrhage of major degree. The rapidly increasing pallor, steady rise in pulse rate and the accompanying hematuria, all point to a hemorrhage into the peritoneal cavity and call for immediate surgical measures. One cannot wait for evidences of free fluid in the abdomen, because to elicit dullness in the flanks, on percussion, means the accumulation of a larger amount of blood than it is safe to permit to escape from the torn kidney. The same is true of spreading rigidity of the abdominal muscles, which also indicates a widespread diffusion of the blood between the intestinal coils, and is of value as an objective finding at too late a stage, usually, to make any operative interference of value in saving life.

5 Those Cases in Which the Symptoms of Primary Shock Are Followed by Those of Internal Hemorrhage In some cases, there is very little, if any shock after the accident. These are the milder cases of superficial tears, contusions, etc. The shock in the more severe cases is not due so much to the injury of the kidney itself as to that of the large nerve plexuses (Figs 32 and 33) in close proximity to the renal pedicle or adrenal gland. In some cases with severe damage to the kidney, the patients show very little primary shock. They are able to walk or even continue at work until the anemia from hemorrhage around the kidney (D of Fig 438) compels them to seek medical aid. It must not be forgotten that the pallor, small rapid pulse, etc., in the first hours, may be due to shock as much as to hemorrhage. The primary shock when severe, is often accompanied by emesis, singultus and abdominal distention (reflex renal ileus), which may also be the result of nerve-plexus injury, as much as of that of the kidney itself. The primary shock may last for hours to days. In some cases where it is not a prominent feature at the outset, it may appear later (secondary shock) as the result of hemorrhage. However, whenever the primary shock is prolonged,

e.g., more than twenty four hours and there are signs of internal hemorrhage (increasing pallor steady rise in pulse rate with diminution of volume restlessness thirst etc.) one should be suspicious of serious kidney injury, especially if there is a history of force exerted over that region, even when hematuria is absent because this may be due to division or occlusion by a clot of the ureter.

6 Rapidly increasing signs of internal hemorrhage either associated with or following the primary shock or independent of the latter. In these cases the evidences of internal hemorrhage predominate from the onset and the primary shock symptoms pass almost imperceptibly into those of hemorrhage. The steadily increasing pallor cold skin rapid small soft pulse thirst restlessness, etc., should lead to careful examination of the urinary tract whether hematuria is present or not. If there is marked and persistent hematuria the localization of the source of the internal hemorrhage is not difficult. If however there is an absence of hematuria, one must exclude rupture (subparietal) of the liver and spleen by the presence of more generalized abdominal rigidity in such intra peritoneal visceral injuries.

DIAGNOSIS

As has just been outlined there are a number of clinical pictures under which kidney injury presents. The outstanding features of these in the order of their frequency are hematuria shock signs of internal hemorrhage localized pain rigidity and gradually increasing swelling over the injured kidney and signs of peritoneal irritation. Of all of these hematuria is the most characteristic evidence of kidney injury. It is so seldom absent that when present one can be certain of a correct diagnosis having been made even without any of the above mentioned accompanying symptoms and findings provided bleeding from the lower urinary tract (bladder and urethra) can be excluded. Bleeding from the latter is never as profuse and persistent as that from the kidney. If there is any doubt it is permissible to inspect the bladder and ureteral orifices cystoscopically so as to determine the source of the bleeding. This is especially indicated if an oliguria or anuria cannot be relieved by any other means than ureteral catheterization with dislodgment of an occluding clot in the ureter. The presence of shock alone does not mean an injury of the kidney. If there is absence of hematuria rigidity and pain. Shock of an equally severe character occurs in so many other abdominal and thoracic injuries that one must often wait for at least six hours for the shock symptoms to improve before it is possible in a subparietal abdominal injury to determine which viscus is involved. If the symptoms of shock are accompanied or pass imperceptibly into those of internal hemorrhage as detailed above and there is an accompanying hematuria then a diagnosis of a severe kidney injury is possible at a comparatively early period.

Associated injury to bony structures and other viscera are frequent and often confuse the picture.

If on the other hand the symptoms of shock are not marked but there is gradually increasing anemia, cold dry skin and extremities a small thready pulse thirst and restlessness and an accompanying hematuria one does not need any other data upon which to base a diagnosis of serious kidney injury. At a later period i.e. after the first six to twelve hours the presence of localized rigidity and tenderness and a gradually increasing swelling over a kidney region as well as a hematuria taken together all speak for kidney injury.

One should always be suspicious of the injury of an important (liver, spleen or kidney) solid upper abdominal viscus, if there is evidence of fracture of the lower ribs plus the signs of internal hemorrhage. If hematuria accompanies these findings, the diagnosis of kidney injury is not difficult.

When there is escape of blood into the peritoneal cavity, there is a predominance, at least in the early hours after a kidney injury, of the symptoms of internal hemorrhage accompanied by slight, but diffuse, rigidity of the abdominal muscles. After the first twenty-four hours, if the bleeding has not been severe enough to threaten life, the symptoms of peritoneal irritation (tympanites, vomiting, obstipation, etc.), become more and more prominent and, taken in conjunction with a hematuria, confirm the diagnosis of a communication of the torn kidney with the peritoneal cavity.

Excretory Urography This has proven to be a very important addition to our diagnostic resources in injuries of the kidney, especially in recent cases. Wood (Jour Urol 1937, 37, 437) states that an excretory urogram is indicated as soon as possible after the injury, except in extreme cases. It was employed in seventeen of twenty-five cases at the Brady Urological Institute. Excretory urograms in ten of twelve cases, treated conservatively, indicated no major damage to the kidney, its pelvis or ureter. The clinical course was satisfactory in all but two of the twelve cases. One of these died following an operation for head injury and the other of an unrecognized rupture of the kidney with associated injury of the mesentery and peritoneum. Excretory urography was not employed in this case.

In a second group of cases, excretory urography revealed a rupture of the kidney which served as an indication for operative intervention.

TEMPORARY ANURIA If the injury is severe, the kidney may show a temporary anuria of the involved side, and there will be no excretion of the contrast medium for the first 24 hours. This failure of one side to secrete is in itself diagnostic and together with clinical findings establishes the diagnosis. The torn surface of the kidney does not secrete urine, but sufficient contrast material is excreted in the uninjured portion to outline the point of rupture. In our series an intravenous urogram made two weeks following a severe injury showed a marked hydronephrosis with blocking of the ureter as the result of distortion and incipient scar formation. The method is, therefore, also of diagnostic and prognostic value after the acute symptoms have subsided. Excretory urography may be of little value in the presence of active bleeding or clots in the renal pelvis. The contrast medium may be obscured in either retrograde or intravenous urography by the free and clotted blood in the pelvis and calices and give no roentgenographic shadow or such a distortion of the pyelographic outline that it does not give a true picture of the degree of damage. The value of plain films in the early diagnosis of renal injuries is limited. The history of injury, evidence of external trauma and hematuria establish the diagnosis. The patients are usually brought to the hospital suffering with some degree of shock, together with injuries to the ribs or pelvis, and very early develop "renal ileus" with distention of the bowel. All this makes a plain film of little value. In the transcapsular ruptures with a swelling in the loin due to a hematoma there may be radiographically a distortion of the renal shadow and obscuration of the psoas muscle, if this is not itself obscured by the distended bowel. The clinician must, therefore, depend in the main upon objective evidence for the early diagnosis of renal injuries and

the extent of the injury in recent cases. It is often difficult to determine whether there is associated injury of the intraperitoneal viscera. As a rule such patients died within a few hours after reaching the hospital. The reflex paresis of the bowel makes the differential diagnosis between an intraperitoneal visceral involvement and an injury to the kidney difficult. In some cases, the marked intestinal paresis with the acute dilatation of the stomach (Fig 748) that accompanies the severe injuries often gives the impression of associated intraperitoneal visceral involvement. There are a number of reported cases of retroperitoneal hematoma following kidney injury which were diagnosed as peritonitis and the error only discovered at operation. Retroperitoneal hemorrhage due to fracture of the spine may also be mistaken for an injury of the kidney.

We operated on one patient who had a transient hematuria and then developed a swelling in the loin which was due to injury to the vertebrae.

The diagnosis of a kidney injury after the lapse of a week or more depends on the localization in one kidney, of the bleeding by cystoscopy and ureteral catheterization by the decreased function on this side and later excretory or retrograde urography or both in order to ascertain the extent of damage. If one wishes to determine the presence of a traumatic ureteral stricture with secondary hydronephrosis, the methods of diagnosis are those outlined in Chapter 30.

We have made a number of retrograde urograms from two to five weeks following injury but ureteral catheterization and urography in the presence of hematuria from a recent injury of a few days duration carries with it the danger of further damage to the kidney and increasing the hematuria. If the bleeding ceases within a few days ureteral catheterization at this time may cause resumption of the hematuria. Above all the greatest danger at this time is secondary infection. There is also the danger of embolism resulting from urography in a recently damaged kidney. Late results of extensive trauma to the kidney treated conservatively show marked destruction and distortion (Figs 441 and 442) of the urogram with filling defects simulating renal tumor.

TREATMENT

The chief dangers of kidney injuries are death from hemorrhage during the early and from infection at a later period. Anuria with subsequent death from uremia only occurs if the injured kidney is a congenital solitary one or the opposite organ fails to function as the result of hypoplasia (Fig 397) or of destruction by disease or when it has been removed. The treatment can be divided as follows:

- 1 Expectant i.e., conservatism.
- 2 Operative

1 Expectant Treatment. Conservative i.e. Non-operative Treatment. In the opinion of those who have had a large experience this is the treatment of choice. Four of our series of 30 patients died of associated injuries. These could not be considered as deaths due to renal injury. Of the 26 remaining cases 3 were operated upon and 23 treated conservatively. One of the 26 died. However in view of the urographic findings one year later and the persistent pain and marked damage to the kidney as ascertained later some of the patients treated conservatively should have had operative interference within a few weeks after the injury.

2 Operation is indicated under these conditions

(a) IF THE HEMATURIA IS SO SEVERE AND PERSISTENT AS TO THREATEN LIFE This is shown by the rapidly increasing pallor, rise in rate and decrease in volume of the pulse and steady diminution in the number of red cells and percentage of hemoglobin, as determined by hourly counts

(b) IF THE SIGNS OF INTERNAL HEMORRHAGE as indicated by the symptoms, etc., just enumerated, are increasing rapidly, even when the hematuria is moderate in degree

(c) IF SEVERE BLEEDING RECURS after it has ceased for a few days, operative interference is indicated

(d) IF FEVER, CHILLS, TUMEFACTION OVER THE ILIACOSTAL SPACE AND OTHER EVIDENCE OF INFECTION of a perinephritic accumulation of blood and urine or when a urinary fistula are present

A peritoneal tear is not an indication for operation, if there are no signs of internal bleeding at an early stage or of infection at a later one

(e) OPERATION IS ALWAYS INDICATED IF ONE IS SUSPICIOUS OF CONCOMITANT INJURY OF ANY OF THE INTRAPERITONEAL VISCERA

Conservative management includes absolute rest for at least two weeks after the injury, even though the hematuria has been slight or has entirely disappeared. If the hematuria recurs after exertion or persists for several months, so as to give rise to anemia, conservatism should be discarded before it is too late to operate

Specimens found at autopsy a long period after an injury as well as pyelograms (Figs 441 and 442) made one year after injury, indicate that recovery with good function is possible even after severe injury. If a fistula persists after drainage of a suppurating perirenal hematoma or urinary extravasation, it will not heal, until all of the remaining kidney has been removed. A nephrectomy may also be indicated, if it is impossible to dilate a traumatic stricture of the ureter or if a large hydronephrosis is a sequel of injury

2 Operative Treatment Minor injuries which would only require gauze packing or suture of the capsule get along best by non-operative treatment. Partial nephrectomy with packing is not satisfactory, the possibility of secondary infection is too great. When the injury is severe, nephrectomy should be done

From a technical standpoint, removal of a severely injured kidney in the first days, presents many difficulties on account of the inaccessibility of the pedicle. This is due to the large amount of blood and urine in the perirenal tissues and the inability to deliver easily, a pulpified kidney into a lumbar incision. The large vessels are often found temporarily occluded by thrombi which are easily dislodged, so that free bleeding occurs, making it difficult to locate the short, often retracted stumps of the renal artery and veins. Our experience in a large hospital with many casualty cases, has impressed us more and more with the advisability of not attempting early nephrectomy unless the indications mentioned above, demand such interference

INJURIES OF THE KIDNEY WITH EXTERNAL WOUNDS⁴

These differ chiefly from subparietal injuries in the manner in which they are produced and the more frequent association of injury of other abdominal

⁴ An excellent article on the subject is that of Dr D C Straus published in the *Surgical Clinics of North America*, Vol 2, No 3, June, 1922

and thoracic viscera. Those due to sword, bayonet, dagger and knife injury are clean cut or contused and vary much in depth. They may detach a lower or upper pole of the kidney. In those due to projectiles e.g., bullets (Fig 443) shell fragments etc. the kidney is ruptured by hydraulic action just as in subparietal injuries (see beginning of chapter) and hence the various types of penetrating resemble nonpenetrating wounds, in nearly every detail. The capsule, however is always torn. The missile may remain imbedded in the parenchyma or find its way into the pelvis. The kidney may be perforated by the ends of a broken rib. Particles of clothing may also be imbedded in the kidney. When the external wound is large as in shell wounds, necrosis follows injury of the main vessels. Extravasation of urine into the perirenal tissues occurs, if the renal pelvis is opened just as it does in subparietal injuries.



FIG 443.—Specimen removed at operation illustrating severe injury of the kidney following gunshot wound. Note complete pulpification along track of missile extending into pedicle (Courtesy of Dr. D. C. Straus.)

In the report of the medical department of the United States Army (Volume XI) on the World War one finds that wounds of the kidney constituted 6.3 per cent of all abdominal injuries. In only one-half of the cases were they uncomplicated by other abdominal injuries. In one-third of all cases of wounds of the right kidney there were also liver injuries. Wounds of the left kidney were accompanied by splenic lesions, almost as frequently. The hollow viscera most often wounded are the small intestine or colon, while stomach lesions are less frequent.

EXTERNAL PENETRATING WOUNDS

CLINICAL PICTURES AND DIAGNOSIS OF PENETRATING WOUNDS

These resemble so closely those seen in subparietal injuries that it would only appear to be necessary to emphasize the points of difference. Radiography gives important information as to the location of broken ribs and of the missile. Secondary hemorrhage is more frequent in penetrating than in subparietal injuries. Out of forty two cases arriving at a base hospital with kidney lesions nine suffered a secondary hemorrhage one on the seventh five between the tenth and fifteenth days and two after four weeks.

The diagnosis is based on the clinical picture excretory urography plain radiography and the location to the wound of entrance and of exit (if latter exists)

TREATMENT

Conservatism should be the keynote in the treatment of injuries of the kidney due to gunshot and stab wounds. One of our patients had a gunshot wound with separation of the lower pole as confirmed three weeks later by retrograde urography. He made an uneventful recovery with expectant treatment. Another patient had been stabbed in the loin—this was followed by hematuria which disappeared within a few hours, but bleeding from the external wound continued. At operation, the hemorrhage was found to be due to injury to the superficial vessels of the lumbar region. There was a stab wound in the kidney, but a clot had already formed and complete hemostasis had occurred. The kidney was not disturbed. This patient would have recovered without operation. Alarming hemorrhage, urinary leakage, symptoms of infection or a large retained foreign body are the principal indications for operative intervention. A complicating intraperitoneal visceral injury requires immediate operation. The abdominal incision, of choice, is the usual lumbar kidney incision which may be extended forwards (Fig 689) to treat intraperitoneal complications. If a small lacerated wound of the kidney with retained foreign body exists, removal of the missile and drainage may be all that is necessary. Nephrectomy is indicated if there is life threatening hemorrhage into the wound as the result of serious damage to the vessels or parenchyma, or where primary or secondary hematuria is so severe, as to indicate a less conservative policy.

The mortality in uncomplicated cases was twenty-five to thirty per cent during the World War. The cases in advanced areas succumbed to hemorrhage, while those in the rear areas, died of sepsis and secondary hemorrhage.

SPONTANEOUS RUPTURE OF THE KIDNEY

Henline⁵ found only twenty-four reported cases and added one. Since that time (1924) we have found another case report.⁶

The symptoms are usually the same as in traumatic rupture (sudden severe pain, signs, etc.). One of the cases was a spontaneous rupture of the kidney, which presented a marked bulging in the loin and intermittent chills and fever indicating a perinephritic abscess. At operation a urinary extravasation was found due to a spontaneous rupture of an old calculous pyonephrosis. Although a diseased kidney is less likely to rupture following an injury because of the thickening and fibrosis of its capsule, there may be areas only slightly fibrosed with only a shell of a kidney present so that even spontaneous rupture may occur as in this case. It is often well to know the previous history of the patient. In two of the subcutaneous injuries there were definite evidence and history of a previously existing pyonephrosis. A very slight trauma may produce rupture of a pathologic kidney, this should be of interest to industrial surgeons. One of our patients was a hemophiliac, hematuria was extensive, continued for many days and required repeated blood transfusions. His injury had not been severe.

⁵ J A M A 1924, 83, 1411

⁶ Zeit Urol 1926, 20, 561

CHAPTER 34

ANOMALIES AND URISMS AND THROMBOSIS OF THE MAIN RENAL VESSELS

ANOMALIES
ANEURISM OF THE MAIN RENAL ARTERY OR ITS BRANCHES
ETIOLOGY
TREATMENT
PERINEURAL HEMATOMA
INCIDENCE AND ETIOLOGY
CLINICAL PICTURES
DIAGNOSIS
TREATMENT

INFARCTION OF THE KIDNEY
SITE
INCIDENCE
ETIOLOGY
EFFECTS ON KIDNEYS
SYMPTOMS AND DIAGNOSIS
TREATMENT

ANOMALIES

The fetal kidney until it reaches its final location in the lumbar region receives its blood supply from multiple arteries and veins which have their origin in vessels immediately adjacent to the kidney during its ascent. These multiple arteries and veins disappear except in the majority of cases a single artery and vein which will form the permanent renal pedicle. The persistence of a multiple blood supply is found in the alligator and in most birds.

Types of Anomalous Blood Vessels in the Human Kidney These are of much clinical importance because of their relation to the renal pelvis and ureter in the etiology of hydronephrosis.

Incidence of the Different Types The following table includes the results of cadaver observations made on 418 kidneys by one of us alone and in association with D. C. Strauss as well as those made by others.

REPORTED BY	NUMBER OF KIDNEYS	UPPER POLAR FROM AORTA	UPPER POLAR FROM MAIN RENAL	LOWER POLAR FROM AORTA	LOWER POLAR FROM MAIN RENAL	LOWER POLAR FROM ILLACS	TWO MAIN RENALS	THREE RENALS	FOUR RENALS
English and Irish anatomists	49	29		1					
Seldowitch	300	4		8					
Elsendrath & Strauss	200	5	19	7		1			
Rupert	100	7		8					
Elsendrath	28	13	49	3	1	1			
Queredo	60	13		6					
Hellstrom	200	14	44	5			38	4	1
Totals	49	95	1	8	1		38	4	1

This table shows that one can expect to find upper polar arteries arising either from the aorta or a main renal artery in one out of about seven kidneys

and lower polar arteries from the aorta or main renal artery in one out of about sixteen kidneys

We regret that no distinction is made by Anson, Richardson and Minear (*Jour Urol* 1936, 36, 173) between the incidence of accessory arteries and veins to the upper and lower poles. They simply state that in 400 kidneys studied by them 47 per cent had accessory arterial branches. Of this 47 per cent, accessory renal arteries passed to the extremity of the kidney (on both sides) from the aorta in 15 per cent and from the main renal in 16 per cent.

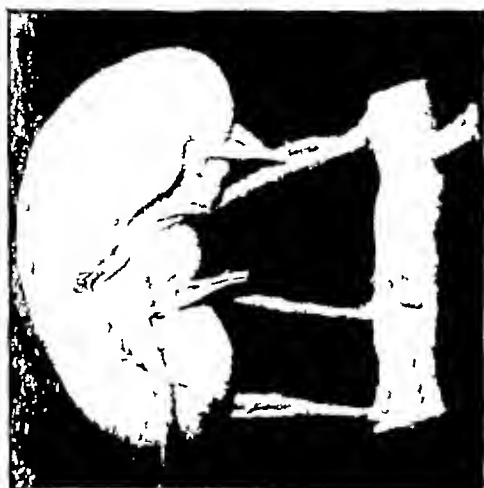


FIG 444—Necropsy specimen showing accessory (polar) arteries to upper and lower poles of kidney

Various combinations of polar arteries are found, such as (a) superior and inferior polars, both arising from the aorta or main renal (Figs 24, 26 and 444), (b) inferior or superior polars on one side only or on both sides, and (c) superior and inferior on one side and only a superior or an inferior on the opposite side.

Usually the accessory vessels to the poles are either an artery alone or an artery and vein, rarely the latter alone.

Anomalies of the retroperic vessels will be discussed in the chapter on technic of kidney operations, because of their importance in relation to pyelotomy.

ANOMALIES OF THE MAIN RENAL VESSELS

Clinical Importance These were formerly considered of little clinical importance but the number of reports to the contrary is rapidly increasing (Fig 445). Cases have been reported by Rowland, Gruber and Bing, Gregoire, Bergen-

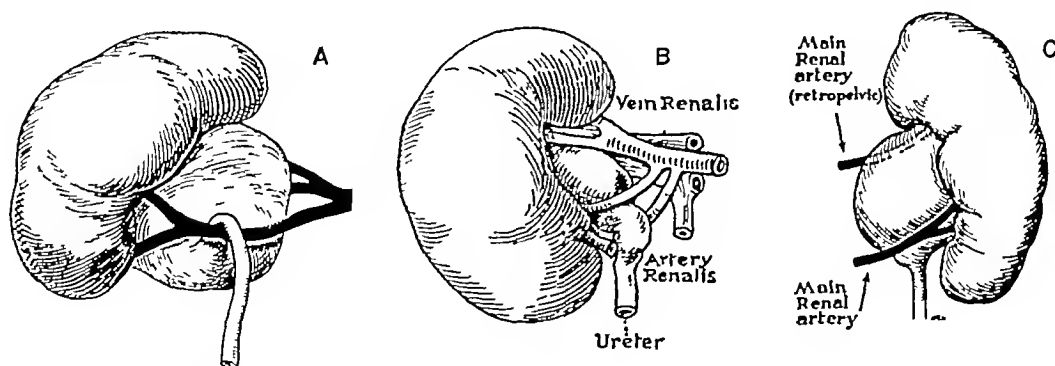


FIG 445—Various types of vascular obstruction of renal pelvis by main renal arteries. A Obstruction by one of the branches of the main renal artery (Gregoire) B Obstruction by two branches of the main renal artery (Gruber and Bing) C Obstruction by one of two main renal arteries (Eisendrath)

dal and one of us (*Jour Urol* 1930, 24, 173) in which a hydronephrosis was either to ureteral obstruction by a branch of the main renal artery (A and B of Fig 445) or as in our own case (C of Fig 445) to one of two main renal arteries, compressing the renal pelvis. In this connection, the statistics of Anson,

Richardson and Minear (*loc. cit.*) are of importance. In 200 kidneys, they found one accessory artery in 44 per cent, two accessories in 8 per cent and three in 2 per cent.

Polar and Accessory Main Renal Vessels. A knowledge of the existence of both of these types of vascular anomalies is essential for two reasons:

1. Their relation to accidents during operations on the kidney and upper ureter.

FIG. 446



FIG. 446—Specimen of kidney removed at operation because of advanced pyelonephritis and perinephritic abscess. Two polar arteries (inferior and superior) had been ligated three weeks previously. Note necrosis of upper and lower poles. (Courtesy of Dr. Irwin S. Koll.)

FIG. 447—Reconstruction of conditions found at operation in one of our cases of ureteral obstructio due to accessory lower polar vessels. Note how artery passes in front and vein behind ureter with resultant compression of the ureter and hydronephrosis.

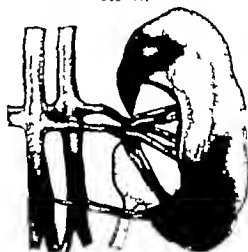


FIG. 447

2. The relation to the etiology of hydronephrosis.

1. THEIR RELATION TO SURGICAL ACCIDENTS. An anomalous artery or vein to the upper or lower poles or an accessory renal artery or vein to the upper or lower poles or an accessory renal artery or vein may be torn during an operation. If recognized immediate ligation usually can be accomplished without difficulty but if overlooked the post-operative hemorrhage may be so severe as to necessitate reopening the wound and doing a nephrectomy under unfavorable conditions. Cases

have been reported by Israel and others of fatal hemorrhage from an overlooked tear of a polar artery. We will describe in the chapter on technic of kidney operations the method we routinely employ in the search for polar vessels.

Whether a polar artery can be ligated without danger of anemic necrosis of the kidney area supplied by it is still being debated. Some surgeons maintain that one can ligate any polar artery without any hesitation. Others believe that

a small artery can be safely ligated but in the case of larger ones, every effort should be made by some type of plastic operation (see Chapter 53) to avoid ligation. One of us was obliged to remove a kidney (Fig 446) in which both the upper and lower polar vessels had been ligated elsewhere. The extensive areas of anemic necrosis of both poles show that one should hesitate before ligating an artery larger than the lead of an ordinary pencil. It has been proposed that before ligation is attempted, the vessel should be compressed and the degree of anemia of the area supplied by it, noted, but this is not always a reliable test.

2 RELATION OF LOWER POLAR VESSELS TO HYDRONEPHROSIS (Fig 447)
Whether the vessel, through its compression of the ureter, is directly, i e, primarily



FIG 448—Retrograde urogram in case of hydronephrosis (left) due to obstruction by the lower of two main renal arteries. Note sharp line of demarcation at lower border of pelvic shadow. Compare with Fig 445.

responsible for the hydronephrosis or whether a movable kidney is the primary factor by producing a kinking or suspension, of the ureter, across the anomalous vessel when the kidney drops, is still being actively debated. There are as many who support the former opinion as there are others who oppose it. The question is far from being settled. There are cases in which the vessels are found in close relation, either behind or in front of the ureter, yet no hydronephrosis has resulted. Again there are cases of mobile kidney in which lifting the kidney does not have any influence in relieving the obstruction. At operation, it is very difficult to determine whether the vessel was the primary cause or not. There is a tendency at present to avoid ligation of a lower polar vessel if it can be done and to perform some type of plastic operation or re-implantation of the ureter in order to avoid ligation (see Chapter 53). If, in a given case, the kidney is found to be abnormally mobile, nephropexy is also indicated. Whether this latter mode of treatment, alone, will suffice, can only be determined by the relief of symptoms following its employment supplemented by urographic follow-up examinations, preferably by excretory urography as to whether the hydronephrosis has decreased.

The superior polar vessels never give rise to symptoms and are chiefly of importance if torn during operations

SYMPTOMS AND DIAGNOSIS OF VASCULAR OBSTRUCTION OF THE URETER The symptoms due to vascular obstruction at any level of the ureter do not differ in any respect from those due to any other type of mechanical obstruction or those incidental to stasis in the upper urinary tract as the result of neuromuscular dysfunction. Until infection supervenes the chief symptoms are pain of a dull aching persistent character or the frequent recurrence of such a dull pain or of attacks of pain of a more colicky character. On palpation of the kidney, it is often found enlarged especially immediately after an attack of pain. Persistent enlargement of the kidney is found in all cases of hydronephrosis the degree being dependent upon whether the obstruction to the escape of urine from the renal pelvis is of a permanent or intermittent character. In the latter type of

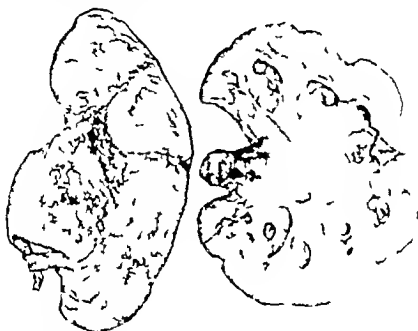


FIG. 449.—Operative specimen showing ureteral obstruction by lower polar vessel and resultant hydronephrosis.

hydronephrosis the size of the palpable mass varies from time to time. When infection is added to the stasis the symptoms are those of an acute or chronic renal infection (Chapter 39).

LEVEL OF OBSTRUCTION It was formerly believed that the only level at which vascular obstruction of the ureter could occur was just below the ureteropelvic junction and was due to anomalous vessels to the lower pole of the kidney which had their origin from the aorta and vena cava or from a main renal artery or vein. We are now obliged to add other levels at which vascular obstruction can take place in view of other reports. These different levels from above downwards and the type of vessel are

- 1 At the level of the renal pelvis by a main renal artery or its branches (Fig. 445)
- 2 Just below the ureteropelvic junction (Figs. 447, 448 and 449) by an anomalous artery or vein from the aorta, iliacs, etc., rarely by a vein alone
- 3 In the course of the lumbar portion of the ureter. In this group are to

be included the postcaval ureter (see Fig 350) or obstruction due to an anomalous artery from the aorta (case reported by Lippow, *Zeit Urol Chir* 1929, 27, 496)

4 In the pelvic portion of the ureter, as in cases reported by Hyams (*Surg Gynec and Obst* 1929, 48, 474) and by Levi (*Zeit Urol Chir* 1929, 23, 1001)

We have mentioned all of these different levels at which vascular obstruction can take place, because they must be kept in mind, in the interpretation of urograms

EXCRETORY AND ASCENDING (RETROGRADE) UROGRAPHY are the most reliable methods of diagnosis The former yields excellent visualization down to the



FIG 450—Bilateral urograms from case in which nephrectomy was performed because of an advanced degree of renal (left) infection due to complete ureteral obstruction by a lower polar artery arising directly from the aorta There is an indication of a filling defect on the opposite side (marked R) just below renal pelvis as though a polar artery were to be found here in the future

level of obstruction, provided, first, that the functional capacity of the kidney is not reduced to such an extent, by pressure atrophy, as to prevent enough excretion to take place to obtain a satisfactory visualization proximal to the level of obstruction, and second, that the latter is sufficiently complete to impede the opaque medium from passing too rapidly into the bladder, through the obstructed area Ascending urography is especially to be recommended in order to demonstrate the characteristic filling defect (Fig 450) in cases of obstruction close to the ureteropelvic junction by anomalous vessels to the lower pole of the kidney In our case (Fig 445) of obstruction of the pelvis by one of two main renal arteries, the difference in density of the shadow above and below a horizontal line near the ureteropelvic junction was noted before operation but was not correctly interpreted until at operation a large artery was observed to pass across the pelvis, just proximal to the ureteropelvic junction (Fig 445)

TREATMENT OF VASCULAR OBSTRUCTION OF THE RENAL PELVIS AND URETER This depends chiefly upon the symptoms and degree of stasis and concomitant

infection. If urography reveals prolonged (more than one hour) retention of the opaque medium and functional tests indicate advanced renal destruction operative intervention is unavoidable, especially in infected cases. Anomalous arteries in the lower portion of the lumbar and in pelvic ureter can be safely ligated. Nephrectomy is indicated in cases of postcaval ureter. In advanced hydronephrosis whether infected or not, due to vascular obstruction close to the kidney or at the level of the renal pelvis nephrectomy is indicated if the various types of plastics on the renal pelvis in cases of hydronephrosis discussed in Chapter 53 are not feasible.

ANEURISM OF THE MAIN RENAL ARTERY OR ITS BRANCHES

This is a comparatively rare finding both at necropsy and clinically. As to its incidence at necropsy Gerard (*Jour d'Urol* 1932 34 353) found only five aneurisms of the renal artery in 41 437 necropsies reported by various authors or about 1 in 8000. Including the clinical observations collected by Gerard and by Mathe (*Jour Urol* 1932 27 607) we have found a total of 58 reported cases.

ETIOLOGY

It is necessary to distinguish as to etiology cases of false from those of true aneurisms. The former are the result of a subparietal (without external wound) injury in nearly all cases. Only one case following gunshot and one of stab wound of the artery have been reported. True aneurisms, like those in other parts of the body are due to pathologic changes in the wall of the vessel itself.

False Aneurisms

Laceration of the renal artery usually accompanies a severe injury of the kidney. It may occur independently as shown in a case reported by Edmunds (*Jour Amer Med. Assn.* 1932 99 467).

If death does not follow rupture into the peritoneal cavity soon after the accident the hematoma becomes walled off by a sac formed by the adjacent structures and fibrous tissue proliferation.

Of the 58 reported cases, there was a recent trauma in 22. In three other cases designated by the authors as true aneurisms there was a history of injury from 18 months to 14 years before being seen clinically. A fourth case is reported as a false aneurism resulting from rupture of a true one. If these four cases are added there are only 26 reported cases of false aneurisms.

Ruptures of such false aneurisms have been reported as taking place into the peritoneal cavity and into the renal pelvis.

SYMPTOMS AND OBJECTIVE FINDINGS OF FALSE ANEURISMS OF THE RENAL ARTERY (a) **PRESENCE OF A MASS IN THE KIDNEY REGION.** This is not evident as a rule until several weeks after the injury. The mass is fixed and not very tender on palpation. In four of the reported cases a pulsation over the mass was noted.

(b) **HEMATURIA.** This is a frequent finding either as an accompaniment of the mass in the kidney region or it takes place some time later. The striking feature is its tendency to be intermittent.

(c) **PAIN.** Aside from that complained of at the time of injury the feeling of a tense mass in the upper abdomen has been noted, concomitant with the increase in size of the sac.

True Aneurisms

Here the sac is formed by one or more coats of the artery. As stated above, the etiology is the same as that of nontraumatic aneurisms of other vessels. As a rule, the true aneurism is found close to or even within the hilus of the kidney.

If the three cases are excluded in which there was a history of trauma at a variable period, before the patients were first seen, we have found 32 reports of true aneurisms. The size varied from that of a bean to that of an apple. The aneurism may be sacculated or fusiform. Calcification of the wall was noted in a number of cases as in the false variety. Rupture into the renal pelvis in two cases, and in one the sac communicated with the aorta. In two cases (Carson, J. J. Valentine) bilateral aneurisms were found.

In a case reported by Hinman, the aneurismal condition was shown to be a part of a generalized periarteritis nodosa.

SYMPTOMS AND OBJECTIVE FINDINGS OF TRUE ANEURISMS The most constant symptom is pain referred to the lumbar region or upper part of the abdomen. Hematuria or the presence of a mass are not as frequently observed as in the false variety. The clinical picture so often resembles that of renal calculus or neoplasm that operation is often done with one of these as the tentative diagnosis.

The pre-operative diagnosis of both false and true aneurisms of the renal artery has been made in only eight cases prior to operation or death.

In Key and Akerlund's case, plain radiography revealed the presence of a uniformly round shadow, the size of a dime, with a much darker periphery, located close to the hilus of the kidney. A similar finding in the cases reported by Soderlund and Renck led to a correct preoperative diagnosis. In Callahan and Schlitz's patient, the shadow was the size of a hazel-nut, also at the hilus and with a darker periphery. A similar observation is reported by Kemet. In Mathe's case, the aneurism was within the renal sinus and the shadow presented a calcified edge. In Callahan and Schlitz's case, the extrarenal character of the shadow was verified by urography. In Wesson and Fulmer's case, the peripheral zone of the shadow was also calcified as in Mathe's case.

TREATMENT

Operative treatment should always be done if the condition of the patient permits removal of the corresponding kidney in unilateral aneurism cases. Nephrectomy was successful in 15 out of 16 cases in which it was performed. In one case, removal of the aneurismal sac alone and in another, an aneurismorrhaphy, were successful. Death followed an attempt to remove a sac which communicated with the aorta and death also occurred in an operation for false aneurism in which the kidney was found to be necrotic.

PERIRENAL HEMATOMA

By this is meant a hemorrhage, followed by hematoma formation, beneath the fibrous or into the fatty capsule (Fig. 451) of one or both kidneys. Although the number of cases thus far reported is relatively small, it is important to bear the condition in mind, both in the differential diagnosis of acute and chronic renal lesions, and in that of the "acute abdomen," because of the resemblance

of some of the clinical pictures to which it gives rise, to acute cholecystitis, ileus and other acute abdominal lesions.

INCIDENCE AND ETIOLOGY

Up to 1929 Doll (*Beitr Klin. Chir* 1929, 147 503) was able to find 111 published cases and this number was increased to 178 four years later by Polkey and Vynalek (*Arch Surg* 1933 26 196) Since then a few more cases have been reported.

Although there are many causes of perirenal hematoma, they can be placed in two groups.

1 Injuries and diseases of the kidney and adjacent structures.

2 Those of systemic origin

We will enumerate the most common causes under these two headings

1 Injuries and Diseases of the Kidney

(a) CHRONIC NEPHRITIS The older subgroup of so-called idiopathic or spontane-

FIG. 452



FIG. 451



FIG. 451.—Sohn's case of large perirenal hematoma. Note huge size of hematoma (dark) in proportion to kidney which shows evidence of compression

FIG. 452.—Pyelogram from case of primary thrombosis of renal vein. Note deformity (compression) due to exudate in renal pelvis. An erroneous diagnosis of renal neoplasm was made.

ous cases of perirenal hematoma are believed to have been due to some form of chronic nephritis. Of the 111 cases collected by Doll 26 were reported as "spontaneous or idiopathic," but Doll believes that these were all the result of hemorrhage from the kidney due to chronic nephritis. Gayet (*Proc. French Urol Cong* 1932) reported a case in which the bleeding could be directly traced to the kidney in a patient suffering from chronic nephritis.

(b) INJURIES OF THE KIDNEY ITS ENVELOPES OR VESSELS Fifteen of 111 cases (Doll) were due to injury

(c) NEOPLASMS OF THE KIDNEY OR ITS ENVELOPES Twenty two of 111 cases

(Doll) belonged in this group. The tumor in the kidney may be relatively small. One of us observed a case of a large subcapsular hemorrhage in a case of hypernephroma in which the clinical picture was that of an acute cholecystitis.

(d) **HYDRONEPHROSIS AND RENAL TUBERCULOSIS**

(e) **ANEURISMS OF THE AORTA, RENAL OR OVARIAN ARTERIES** In many of the perirenal hematoma cases in this subgroup, a periarteritis nodosa of the renal or smaller arteries was found.

(f) **HEMORRHAGE OF ADRENAL ORIGIN**, the cases of so-termed "adrenal apoplexy." A typical case is reported by Barthels (*Beitr Klin Chir* 1930, 150, 331).

2 Systematic Causes These include

(a) **HEMOPHILIA** Of 111 cases (Doll), 7 belonged in this subgroup.

(b) **LEUKEMIA AND POLYCYTHEMIA** The only case of perirenal hematoma due to the latter blood disease was reported by MacKenzie (*Tr Am Assn G U Surgs* 1929, 22, 1).

(c) **HEMORRHAGES INCIDENTAL TO ACUTE SEPSIS, SCARLATINA AND OTHER INFECTIOUS DISEASES**

CLINICAL PICTURES

The symptoms greatly resemble those of any acute or chronic abdominal affection, especially the former. Not all cases have a stormy onset, as will be mentioned in the description of the most common clinical picture. In some cases, the clinical course is a latent one extending over months, the perirenal hematoma only being discovered at operation or necropsy.

The most common syndrome is constituted by the triad, (a) severe pain, (b) symptoms resulting from a retroperitoneal hemorrhage and (c) the development of a mass in the upper abdomen.

1 Pain This is usually very severe, referred to the upper abdomen, on one or both sides. At times, it is localized by the patient over one or both lumbar regions. The pain is accompanied by reflex symptoms such as vomiting, rapid pulse, profuse perspiration and pallor. In a few reported cases, the onset is followed by a high temperature, but in the majority it is absent.

2 Symptoms Due to Retroperitoneal Hemorrhage These include those due to the hemorrhage itself, such as anemia, thirst, pallor, etc., and those to reflex irritation of the sympathetic nerve plexuses, resulting in a paresis of the musculature of the intestine first described by Israel as "renal ileus." The resultant abdominal distension and obstipation are so marked that a number of cases have been operated on for acute intestinal obstruction.

3 Gradually Increasing Mass in Upper Abdomen Owing to the frequently accompanying abdominal distension, this is seldom palpable until after several weeks. The mass is fixed, irregular in outline and deeply situated around one or both kidneys.

DIAGNOSIS

This is difficult at the onset, owing to the close resemblance of the clinical picture to all of the different conditions which can give rise to the acute abdomen. Correct preoperative diagnoses have been made in very few cases. Many were operated for ileus, perforation of gastric or duodenal ulcer, cholecystitis, or perinephritic abscess. The sudden onset of severe upper abdominal pain, especially if referred to a kidney region accompanied by symptoms resembling those of internal hemorrhage or of ileus and followed by the appearance of a gradually

increasing deep seated swelling one side of the median line in the upper abdomen should make one think of a perirenal hematoma

Wever and Perry (Jour Amer Med Assn 1935 104 1390) have reported a case in which the clinical picture resembled closely that of nephrolithiasis in the form of severe pain muscular rigidity and a swelling in the right ilio-costal space. At operation a large perirenal hematoma was found. Ten hours after nephrectomy the patient died. At necropsy, the typical lesions of periarteritis nodosa were found in a number of the abdominal viscera and also in the heart.

TREATMENT

This depends upon the etiology. Doll (loc. cit.) found reports of 14 cases following injury which had been operated with 9 recoveries. As to whether cases due to other causes should be operated is still an open question.

INFARCTION OF THE KIDNEY

This is the result of occlusion of either the arteries or veins of the kidney. In the former case the infarcts are of the anemic. In the latter of the hemorrhagic type. The infarction may involve the entire (Plate \) kidney and is termed total or complete or it may involve only one or more areas of parenchyma being termed incomplete.

SITE

The blockage or occlusion takes place in one of the following ways

(a) By an embolus lodged in the main renal artery or one or more of its branches

(b) By a thrombus in the same vessels

(c) By a thrombus in the main renal vein or its branches (Plate \)

The embolism or thrombosis may be uni or bilateral. In the majority of cases the embolic occlusion is a noninfected one although occlusion by an infected embolus may occur in any case in which there is a focus elsewhere in the body. The same is true of arterial thrombosis. Thrombophlebitis of the main renal vein and its branches is as frequently of the suppurative as of the nonsuppurative type. Only the latter is included in this section, because the clinical picture of a suppurative thrombophlebitis resembles so closely that of an acute renal infection that it will be discussed under that heading.

INCIDENCE OF EMBOLISM AND THROMBOSIS OF THE MAIN RENAL VESSELS

Renal infarcts of recent origin are found in about 17 per cent of all necropsies. As to the number of clinical cases one of us (Jour d'Urol 1934 37 (Jan.) 47) collected 30 cases including (Plate \) a personal observation published to that date. Since then 14 additional clinical cases have been reported by Hepler Haines, Uebelhor Heilmeyer and Lippross Schildt, Folsom and Alexander. With the exception of the two last named observations we have information as to whether the occlusion involved the artery or the vein as follows

1 Embolism of the main renal artery or its branches in 6 cases in two of which the occlusion was bilateral

2 Thrombosis of the main renal artery or its branches in 9 cases in one of which it was bilateral

3 Thrombosis of the main renal vein (Plate \) or its branches in 13 cases in five of which it was bilateral

ETIOLOGY

In the 30 cases analyzed by one of us (loc cit) the causes, confirmed either at operation or necropsy, were

1 **Endocarditis and Atherosclerosis** In 15 of 29 cases, i e, in 51.7 per cent, a valvular lesion was found. This high incidence is confirmed by the necropsy observations of Sperling, Barney and Mintz, and Rokitsansky. Sperling in 300 necropsies in which an endocarditis was the cause of death, found infarcts of the kidney in 76 per cent. Barney and Mintz in 136 necropsies in which such infarcts were noted, a cardiac lesion (valvular or myocardial) was found in 93 per cent. In 165 necropsies, on cases of endocarditis, reported by Rokitsansky, infarcts of the kidney were noted in over 10 per cent.

2 **Disease of Peripheral Vessels** In this group there were three cases, one due to thrombangitis obliterans in a young man (our case) and two following a peripheral thrombophlebitis. Haines' case, reported since publication of our paper, was a typical example of this type of primary lesion.

3 **Infection During Pregnancy or Puerperium** Two cases. Since our paper, two cases of symmetrical cortical necrosis have been reported, as complications of pregnancy.

4 **Acute and Chronic Infections** This group includes especially the cases reported as having occurred in infancy and childhood following diphtheria, scarlatina, tonsillitis, enterocolitis, pulmonary tuberculosis, acute and chronic pyelonephritis. There were two cases in this group, in our report, but two others (Hepler, Ueberhor) have been published since then.

5 **Chronic Nephritis** A typical case of this origin has been recently reported by Heilmeyer and Lippross (Deut Arch Klin Med 1936, 179, 80) in which a chronic glomerulonephritis was found in a case of bilateral thrombophlebitis of the renal veins.

EFFECTS ON KIDNEY

After closure of the main renal artery for a period of eight hours, changes take place in the kidney. At the end of 120 hours the kidney is converted into a structureless mass, which although larger at first soon begins to atrophy so that it is quite small by the end of five to six weeks. The extent of the infarction depends on the importance, i e, caliber of the blocked vessel. If the main renal artery is blocked, pale yellowish areas surrounded by deep red hemorrhagic zones are noted (Plate X) on the surface and on section. The function of the kidney is entirely suppressed in complete infarction, so that if bilateral occlusion of the main artery or vein has occurred, oliguria followed by anuria results.

SYMPTOMS AND DIAGNOSIS

Pain, hematuria, oliguria and albuminuria were the most constant symptoms in the 30 cases which we have analyzed (loc cit).

The presence of a mass in the kidney region, fever, chills, vomiting and symptoms of collapse were less common.

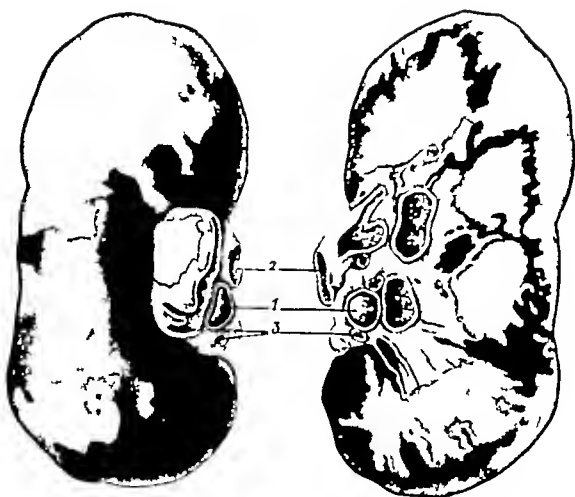
The pain is the most characteristic symptom at the onset. It is referred to the kidney or one of the upper abdominal quadrants and appears suddenly. The appearance of the syndrome, pain, hematuria, oliguria or anuria should always

PLATE X

Drawing made two hours after nephrectomy for a large infarction of kidney due to thrombosis of main renal vein

- 1 The renal vein which contains a clot that completely obstructs the vein
- 2 Ramifications of the pelvis showing a blackish color owing to the bloody exudate adherent to the walls

The lumen of the renal artery (3) is not filled by clot (Courtesy Masson et C^{ie}, Paris)



lead to the search in the clinical history and findings on physical examination, for any of the various causes of renal infarcts mentioned under etiology

Pre-operative Diagnosis

A correct pre-operative diagnosis was only made in two cases, those of Bull and of Aschner. In the former the absence of any indigocarmín elimination from the left kidney and the clinical history of the sudden appearance of severe pain in the left upper abdominal quadrant and of vomiting in a patient with a valvular lesion, led to the pre-operative diagnosis of infarction of the left kidney confirmed at operation. Aschner also based his diagnosis on the same finding viz absence of indigocarmín elimination from the left kidney in a patient in whom the onset was sudden with severe pain over the left kidney hematuria and later chills and high temperature. A complete occlusion of the left renal vein was found at operation. Ehrstrom (Nord med. tidsk. 1934 page 196) made a diagnosis of left renal infarction with the aid of excretory urography in a patient having endo- and myocardial lesions. On the fifth day there was normal visualization on the right but none on the left side. On the eighteenth day retrograde urography revealed normal urograms on both sides. On the twenty third day there was still poor visualization of the left renal pelvis by the excretory method but on the fortieth day excretory urography revealed good visualization of both pelves. Ehrstrom's case was not operated so control of his diagnosis is not at hand. Schildt (Acta Chir Scand 1933 70 Nos. 4 and 5) reported nine cases but no details are available as to diagnosis or treatment. The pre-operative diagnosis in 11 cases were as follows

Perinephritic abscess (Barney and Mintz)

Renal neoplasm (Biernath Eisendrath (Fig 452) Folsom and Alexander Hepler)

Nephrosis (Heilmeyer and Lippross)

Acute pyelonephritis (Marion McKenna Uebelhör)

Acute entero-colitis (Riha)

In two of the cases in which the diagnosis of renal neoplasm was made the deformity of the urogram (Fig 452) due to the presence of clots or exudate in the pelvis was the cause of the error

Haines (Jour Urol 1935 33 464) made a tentative diagnosis of thrombosis of the renal vein because of the symptoms of renal infarction appearing after a phlebitis of the right leg. It is of interest to note that in his case the entire kidney was expelled spontaneously from an incision employed to drain the kidney.

Excretory Urography Failure to obtain visualization of the infarcted kidney by excretory urography combined with absence of elimination of dyes and urine from the same side will undoubtedly be of much value at least in unilateral cases in the future when considered in conjunction with the clinical history and objective examination for cardiovascular lesions. The onset of anuria is indicative of bilateral infarction

TREATMENT

In bilateral occlusion of either the renal artery or vein all operative measures are contraindicated. Nephrectomy was successful in the cases reported by Marion (two cases) Duvergey and Dax Eisendrath Biernath and decapsulation in Aschner's case. Death followed nephrectomy in the cases reported by Bull and by Hepler. In the latter there was later thrombosis of the opposite renal vein.

CHAPTER 35

MOVABLE KIDNEY (Dropped Kidney)

NORMAL KIDNEY
MOVABLE KIDNEY
INCIDENCE, SEX, AGE AND SIZE
ETIOLOGY
MECHANISM OF MIGRATION

PATHOLOGY
CLINICAL PICTURES
DIAGNOSIS
TREATMENT

NORMAL KIDNEY

Range of Mobility of the Normal Kidney

The average range of mobility of the kidney in the normal individual varies from 2 to 5 cm, with an average of 3.5 cm. In addition to its movement in a vertical direction, there is also some rotatory movement on its longitudinal and transverse axes. The right kidney is more mobile, both actively and passively, than the left. The normal kidney sinks 20 to 30 mm (i.e., nearly an inch) in changing from a horizontal to a vertical position, according to Hitzenger and Reich. The ability to feel the lower pole varies according to (a) the form of the kidney, (b) the conformation of the thorax, (c) the relaxation of the abdominal wall, and (d) the individual's adiposity.

A kidney instead of having the normal bean shape (Fig. 134) may be normally much elongated, and hence easier to palpate. Individuals with a long, narrow thorax and abdomen, even without an accompanying splanchnoptosis (dropping of all the abdominal viscera), have kidneys so located (Fig. 14) that they are also much easier to palpate. Helm (Inaug. Diss. Berlin, 1895) called attention some time ago, to the fact that in males the right kidney (lower pole), extends to the crest of the ilium once in nine males and once in about three females.

Mode of Fixation of the Normal Kidney

Both kidneys lie in the upper portion of the retroperitoneal space. Wolkow and Delitzin found that in well-developed men, the renal fossae are deep and also show a gradual narrowing toward the lower (caudal) end of the respective fossae. While in men, the renal fossae resemble a pear (narrow portion below), in shape, they are more cylindric in women and can be even wider at their lower ends. The right renal fossa is wide and deep in men, while in women these dimensions are about equal. The contour of the renal fossae is influenced by the tone of the underlying lumbar muscles (Fig. 14) and by the disappearance of the fat.

The supports of the kidney (normal) are the following:

1. **THE RENAL FASCIA** (see Chapter 2). This is an important mode of fixation because of its attachment to the diaphragm, spine, large vessels and to other abdominal viscera, as well as the many fibrous septa, which traverse the fat.

2. **FATTY CAPSULE**. This varies with the age, sex, and nutrition. It is most developed at the lower end of the funnel formed by the renal fascia. The fat (both peri- and paranephric as shown in Fig. 17) plays only a subordinate role in fixation of the kidney. It may be well developed in cases of marked abnormal mobility of the kidney. There is very little fat in children and yet "dropped" kidney (although not as rare as formerly taught) is not very frequent.

3 THE RENAL PEDICLE This is considered by many as the chief mode of fixation of the kidney Floercken (*Handb für Urol* Vol 4 1927) does not agree with this view basing his opinion on the studies of Legueu and Southam who found that the mobility was not increased after division of the pedicle.

The constant presence of a greatly elongated vascular pedicle in cases of movable kidney (Fig 453) leads us to believe that the pedicle plays a very important part in the fixation of the normal kidney

4 THE VARIOUS LIGAMENTS (hepato duodeno- and lienorenal and the phrenicorenal) may play a slight part in the fixation.

5 THE INTRA ABDOMINAL PRESSURE is of more importance than these ligaments, but far subordinate to the renal fascia perirenal fat and pedicle which we consider the chief factors

MOVABLE KIDNEY

INCIDENCE SEX AGE AND SIDE

Alglave found abnormal mobility in 6 per cent of fifty males and thirty eight per cent in the same number of female cadavers Kelly and Burnam in a collection of 7,853 autopsies, showed that movable kidney occurred in 2.1 per cent of males and 22.8 per cent of females. This is borne out by clinical observation

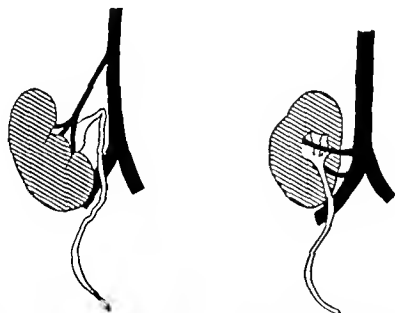


FIG. 453.—How to distinguish a "dropped" (on the left) from a congenital ectopia (on the right). In the former the renal vessels arise from the aorta and vena cava at a much higher level while in congenital ectopia the renal vessels arise immediately from arteries and veins. (Courtesy of Dr. E. Papin.)

Of 538 clinical cases reported by various authors there were 392 females as compared to 146 males. The majority of the patients were between 20 and 40 years of age. In 425 reported cases the right kidney was involved in 285 the left in 62 and both in 78

ETIOLOGY

There is still much discussion as to the causation of movable kidney, hence we will enumerate the various views

1 Relation to constitution of individual, i.e., congenital predisposition These embrace defective development of any of the normal modes of fixation just enumerated These include poorly developed renal fascia itself or of the septa between the renal fascia and the true capsule of the kidney, and a very long or deep (caudal) origin of the pedicle (vessels)

The flat surface of the renal niche or fossa (on the right side especially) in females, also plays a part Southam lays stress on the change from the horizontal position as seen in animals, to the erect position in man With the widening of the bony pelvis in the female, the lower ends of the renal fossae have become more open The asthenic type of individual (Fig 14) is especially prone to develop movable kidney In such persons there is defective development of the mesenchyme (muscular and fibrous tissues) in all parts of the body

2 Influence of Nutrition, Pregnancy and Tight Lacing Hunger and poor nutrition act less through their influence upon the disappearance of the perirenal fat, than upon the lowering of tone, e.g., of the lumbar muscles The relaxed abdominal walls after pregnancy, after removal of large tumors or evacuation of ascitic fluid, undoubtedly favor abnormal mobility of the kidney The part played by tight lacing has been exaggerated Becher and Lenhoff found abnormal mobility in six of twenty-four Samoan women and in forty per cent of all Egyptians who had never worn corsets

3 Effect of Trauma This brings up an important question from the standpoint of accident and industrial insurance As was stated, there should be hematuria or unilateral pain within the first few hours after the accident At times, a symptomless movable kidney may have existed, but only gives rise to crises, etc., after the accident, just as a preexisting hernia may only cause symptoms at the time of, or after an injury A perirenal hematoma may have occurred at the time of the accident and its absorption be followed by abnormal mobility of the kidney

4 The Relation of Splanchnoptosis It cannot be denied that a generalized visceroptosis is occasionally accompanied by a nephroptosis Mathe in his ninety cases, found that in 83 or over 90 per cent, there were no clinical or objective evidences of an accompanying visceroptosis (Fig 14)

MECHANISM OF MIGRATION

This is of importance in connection with the more recent views as to the causation of the pain in the crises (Dietl's), so commonly observed (see below) in movable kidney The latter not only slides down along the posterior abdominal wall but at the same time rotates, with the pedicle as its axis This rotation is around its transverse, less than its vertical axis, so that the upper pole lies more dorsal (i.e., a retroversion) There is less rotation if the pedicle is long than when it is short Federow has pointed out that rotation of a movable kidney can occur without much dropping Braasch gives ptosis as the most frequent cause of cases of renal torsion in which the renal pelvis lies horizontal

PATHOLOGY

The changes incident to movable kidney which are of clinical interest are the following

1 Changes in the Pedicle and Ureter The pedicle is usually longer than in the normal kidney The ureter is also redundant and often shows kinks (Fig

454) in its uppermost portion which F. C. Herrick has shown to be the most mobile portion. That the ureter of a kidney which has a normal range of mobility can show symptomless kinks in urograms has already been pointed out. The

FIG. 454



FIG. 454—Urogram from case of right dropped kidney. Note location of pelvis opposite interspace between third and fourth lumbar vertebrae. Instead of as normally opposite interspace between second and third lumbar vertebrae. Not tortuous course of ureter but absence of any kinks.

FIG. 455—Urogram of hydronephrotic abnormally mobile kidney found in iliac fossa. The specimen of this case is shown in Fig. 467 where one can observe a secondary ureteral kink.

kink may be only temporary, i.e. during the time the kidney has dropped, before returning to the normal location, or it may become permanent as the result of periureteral infection (Fig. 459). A permanent kink is especially apt to be found in connection with a dropped (movable) kidney which is the seat of a hydronephrosis and is also fixed in an abnormal location (Fig. 455).

FIG. 455



2. Hydronephrosis. This may be (a) transitory or (b) permanent (see above). In the former the retention of fluid within the kidney (see Chapter 36 on Hydronephrosis) occurs only during the attacks to be described shortly as

renal crises The more permanent forms of hydronephrosis vary in size according to the degree of ureteral obstruction As the pelvis dilates it tends more and more to compress the ureter in a valve-like (Fig 459) manner, thus not only preventing the escape of urine but favoring infection and still greater fixation of the ureter, to the exterior of the renal pelvis There may, from time to time, be subsidence of the infection, permitting escape of some of the urine, but the hydronephrosis continues to grow in size, because of the constant secretion by the still intact parenchyma

3 Pyelitis This is a frequent complication of movable kidney Crabtree ascribed a very important part to lesser degrees of stasis in ptotic kidneys, in the etiology of long standing colon bacillus pyelitis As will be pointed out in the chapter on nontuberculous renal infections, it is of the utmost importance not to overlook a movable kidney in the treatment of a persistent pyelitis

CLINICAL PICTURES

1 Symptomless, i.e., uncomplicated cases Four hundred and eleven of 526 cases examined by Mackenzie belonged in this group In some, the movable (dropped or sagging) kidney is found by palpation or by urologic study (especially urography) (Figs 135 and 456) during a search for the cause of a persistent pyelitis or analogous condition

2 Those in which a single crisis or recurrent crises are the outstanding feature The syndrome presented by these was first described by Dietl of Vienna, and are usually called Dietl's crises

THE PRINCIPAL COMPLAINT IS SEVERE PAIN, first felt over the corresponding iliocostal space (Fig 379) and upper abdominal quadrant The pain radiates downward along the course of the ureter quite like that of a ureteral calculus (see Chapter 31) It is accompanied by similar reflex symptoms, such as collapse, nausea, vomiting, abdominal distension, inability to pass flatus, rapid pulse, etc Bladder symptoms are inconstant There may be frequency, but inability to void more than a few drops of urine During the attack there is usually oliguria (marked decrease in urinary output), but after it has subsided, a large amount (polyuria), is often passed On account of the reflex muscular abdominal rigidity, it is usually impossible to elicit more than tenderness over the kidney As the attack subsides gradually, one is often able to palpate an enlargement of the kidney The differential diagnosis in such crises must be made from all of the urologic conditions (see chapter on Ureteral Calculi) which can give rise to attacks of colicky pain, as well as from a number of lesions of the intraperitoneal viscera, such as acute appendicitis, passage of biliary calculi, intestinal obstruction, twisting of pedicle of ovarian cyst, etc Hematuria may be present during the attack or follow it

3 Cases in Which the Presence of an Abdominal Tumor Is the Chief Feature The palpable mass may be due to (a) the nonenlarged movable kidney located in an abnormal place or (b) to a hydronephrosis complicating a movable kidney and due to ureteral obstruction Such a tumor may be found at the location of the normal kidney or at a lower level (Fig 455)

4 Chronic Pyelitis Picture In these, there are no symptoms which indicate the presence of a movable kidney as distinguished from those of an uncomplicated infection of the renal pelvis and parenchyma It is only during a thorough urologic

study (see Chapter 10) that a movable kidney as the underlying condition causing the resistance to treatment of a chronic pyelonephritis, is found. In seventeen of Burford's cases the infection only cleared up after nephropexy. In addition to the above one finds associated symptoms of gastro-intestinal disturbance due to the accompanying enteroptosis (Fig. 14)

DIAGNOSIS

This is based on (a) the clinical history of one of the clinical pictures just described and (b) the urologic study

Urologic Study One must never omit a general examination for evidences of functional disturbances such as neurasthenia hysteria etc. because at times the subjective symptoms are out of all proportion to the local findings. Many a nephropexy has failed to afford the desired relief because of the failure to take the condition of the nervous system especially symptoms to be ascribed to disturbances of the sympathetic system and of the endocrine glands sufficiently into consideration. It is also advisable to search for an associated splanchnoptosis (Glenard's disease) before the part played by a nephroptosis is considered by itself

Palpation of the kidney as the chief method of diagnosis has been almost supplanted by excretory and retrograde urography (Fig. 454). One view is made with the patient in the horizontal and the next in the upright position.

The normal emptying time of the renal pelvis is 8 to 10 minutes. In cases of movable kidney any delay should always be noted by taking a series of films at intervals of five minutes for a minimum of 25 minutes as shown in Fig. 457



FIG. 456—A. Typical kink of ureter in a case of dropped kidney with symptoms referable to the kidney

B. A similar case with only vesical symptoms.

TREATMENT

There is still active discussion between those urologists who believe that (a) one should operate on all cases in which pain persists in spite of all efforts to keep the kidney in place by belts etc. (b) one should operate when excretory urograms reveal pyelectasis and (c) one should operate when a pyelonephritis persists in spite of prolonged appropriate treatment. All urologists are agreed that symptomless cases and those which form a part of the condition previously referred to as a generalized visceroptosis (Fig. 14) should not be operated upon

There are a number of urologists who feel however that there are relatively few indications for nephropexy. Braasch (Jour. A. M. A. 1932 98 613) and Bumpus (Urol. and Cut. Rev. 1937 41 465) voice the opinion of many who believe that

1 Renal ptosis without urinary obstruction has no clinical significance and is seldom, if ever, the cause of symptoms

2 Ureteral obstruction as the result of ptosis can always be demonstrated by urographic examination, and that operation is justifiable only in the presence of such evidence

3 In the majority of cases in which nephropexy has been done without previous demonstration of evidence of urinary stasis, the symptoms will return within one or two years following operation



FIG 457—Serial exposures in a case of dropped kidney to show delayed emptying time of renal pelvis

- A Note difference in location of the dropped and normally placed organ
- B Same before withdrawal of catheter
- C Eight minutes after withdrawal of catheter
- D Fifteen minutes after same Note some opaque medium still retained

4 Postoperative urographic examination in the horizontal and upright positions is necessary to determine the permanence of normal renal position as well as improvement in drainage

5 The percentage of patients having nephroptosis who can be relieved of their symptoms by nephropexy will be comparatively small

What has just been said of the debate between those who believe that there are a number of indications for nephropexy and those who maintain that there is only one indication and that is evidence of stasis, is equally true of ureteral kinks. We have pointed out in the chapter on Radiography that such kinks are found in patients who present no symptoms referable to the urinary tract. Bumpus (loc cit) has recently reported two cases in which a marked drop in the position

of the kidney associated with ureteral kinks was noted in the urogram (taken in the upright position) on the side on which there were no symptoms

Before a nephropexy can be termed successful not only must all of the symptoms have been relieved but excretory urography must show at the end of a five year period that the kidney has remained at the level where it was fixed

CHAPTER 36

HYDRONEPHROSIS

DEFINITION

ETIOLOGY

MECHANICAL CAUSES

ADYNAMIC CAUSES

DUE TO NEUROGENIC DYSFUNCTION

PATHOLOGY

LOCATION OF THE ECTASIS

COMPLICATIONS

SYMPTOMS

DIAGNOSIS

TREATMENT

DEFINITION

The term hydronephrosis, implies a retention of urine in the renal pelvis and its calices. The normal capacity is 7 to 10 cc, at times even 15 cc. If there is interference with expulsion of the urine, whether of obstructive or nonobstructive nature, the resultant stagnation causes dilatation of the renal pelvis and its calices and destruction of renal parenchyma. One can thus speak of degrees of hydronephrosis, e.g., small, moderate and large. The condition can be present in only one or in both kidneys. The retained urine can be aseptic or be infected. A hydronephrosis differs from a pyonephrosis (of nontuberculous or tuberculous origin), in the fact that in the latter, there is necrosis or destruction of the parenchyma with formation of cavities as the result of bacterial action, while in a hydronephrosis, there is disappearance of the parenchyma through atrophy, as the result of increased intrarenal tension and interference with nutrition. In a pyonephrosis there is no possibility of return of function, because the parenchyma is destroyed, while in a hydronephrosis, a return of secretory activity of the parenchyma is possible (see later), if the various obstructive and nonobstructive causes to be enumerated, are eliminated before complete atrophy has taken place.

ETIOLOGY

From the clinical standpoint, the simplest division of the causes is into 1 Mechanical and 2 Adynamic, i.e. those due to neurogenic dysfunction.

A MECHANICAL CAUSES

Any type of obstruction below the level of the renal pelvis will sooner or later result in dilatation (pyelectasis) of the renal pelvis and its calices (caliectasis) unless relieved. Beginning with the most distal type of obstruction at the external urinary meatus and proceeding upwards toward the kidney, the locations of the different causes of mechanical obstruction are:

1 In the Penis and Urethra

a Congenital phimosis

b Congenital stenosis of the external meatus

c Congenital (rare) and acquired (gonorrhoeal tuberculous and traumatic) strictures of the urethra

d Congenital valve formation and hypertrophy of the verumontanum (see Chap 46)

2 In the Bladder

a Various types of obstruction at the outlet of the bladder (see Chap 18)

b Obstruction of bladder outlet by ureterocele (Fig 355) bladder neoplasm or large calculus.

c. Obstruction of vesical orifice of the ureter by bladder neoplasm calculus diverticulum or as a result of exstrophy of the bladder

3 In the Ureter

a Stricture of the vesical end of the ureter most often observed in children and of congenital origin

b Stricture of the ureter at any level and of varying etiology (see Chap 30)

c Neoplasms of the ureter primary in the wall or secondary to neoplasms of bladder uterus prostate kidney etc.

d Vascular obstruction This includes all of the different types

FIG. 458



FIG. 458.—Urogram from case of left hydronephrosis of an intrarenal pelvis. The cause of the obstruction was an accessory artery to the lower pole

FIG. 459.—Specimen from case whose pyelogram is shown in Fig 460 Note enormous dilatation of pelvis and comparatively little of calices, as indicated by size of kidney Note ureteral kinking due to secondary inflammatory adhesions.

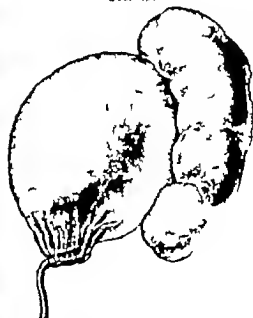


FIG. 459

of vascular obstruction described in Chap 34 such as anomalous vessels passing across the ureter just below (Fig 458) the ureteropelvic junction across the middle of the lumbar ureter across the pelvic ureter and the condition termed postcaval ureter

e Ureteral calculi (Chap 31)

f Ureteral kinks of congenital (Fig 347) and acquired (Fig 456) (movable kidney) origin

g Anomalies of the ureter not included in the above (see Chap 29)

4 In the Renal Pelvis.

a Obstruction by a main renal artery (Fig 445) or vein

b Occlusion of pelvic outlet by a neoplasm (see Chapter 43) or a calculus.

c Anomalies in the mode of junction of the ureter and renal pelvis.

d Strictures (of congenital and acquired origin) at the ureteropelvic junction

B ADYNAMIC CAUSES DUE TO NEUROGENIC DYSFUNCTION

Included in this group are the cases of hydronephrosis in which none of the various mechanical causes enumerated in the first group, can be found. There is, as a rule, an associated ureterectasis (Fig 347) but cases have been reported as congenital hydronephrosis (Chap 32) in which only pyelectasis existed.

Ureterectasis and pyelectasis may also develop, secondarily, as the result of stasis in the bladder (Fig 248) due to some type of neurogenic dysfunction of the bladder (Chap 28). It may also occur primarily, i.e. independently, as the result of disturbances, most commonly of congenital origin, in the innervation of the ureter and renal pelvis.



FIG 460—Bilateral pyelogram showing compensatory enlargement on one side (left half of illustration) as compared to very large hydronephrosis on opposite side due to stricture at outlet of renal pelvis. Pyeloplasty had been done on this side fifteen years before. Compare with specimen of same case shown in Fig 459.

The ureterectasis and pyelectasis observed during pregnancy and in the early postpartum period (see Chap 45) is now considered to be due to the action of toxins on the neuromuscular mechanism of the ureteral wall.

Hydronephrosis of mechanical origin is found in the majority of clinical cases.

PATHOLOGY

The fluid in a hydronephrosis is at first urine, but as the degree of pressure atrophy of the parenchyma increases, it becomes more and more dilute, until finally it is only composed of water and salt. In infected hydronephrosis, the fluid becomes turbid, the degree of turbidity varying with the number of pus cells per high power field. At times, the fluid is bloody (hematonephrosis) as the result of capillary hemorrhages from the compressed renal tissue. A hematuria may be the only clinical sign in such cases (Blatt).

LOCATION OF THE ECTASIS

This may involve (a) the pelvis alone, (b) the calices alone, (c) both pelvis and calices, and (d) a single calyx. In the latter case, a localized hydronephrosis, or caliectasis as it is termed, is usually either the result of a stricture of the neck (narrowest portion) of the calyx or the occlusion of the latter by a calculus. It may occur without such a form of mechanical obstruction, as in a case of Caulk's and in a personal case (Fig 461).

In noninfected hydronephrosis, the papillae become flattened and there is a thinning of the medullary zone. Gradually the cortical zone also atrophies until on section (Fig 462) only a series of cavities with a narrow peripheral margin of parenchyma remains. Hinman has shown, experimentally, that the collecting tubules dilate the earliest and much more than the convoluted. The latter dilate the least but atrophy sooner. The glomeruli are very resistant to increased intrarenal

tension. In the majority of cases the hydronephrosis develops gradually and the obstruction is of such a nature that more or less of the contents of the sac are expelled from time to time (intermittent type) and then the obstruction recurs as the result of ureteral closure and the cycle is repeated. The atrophy of the parenchyma occurs much more slowly in these open or intermittent cases although one can always demonstrate some dilatation of the pelvis and calices in the free interval.



FIG. 461.—A Calculus lying at outlet of left renal pelvis.
B Bilateral pyelogram of same case showing normal right pelvis and hydronephrotic left superior calyx with remainder of pelvis revealing but little change.

The quantity of fluid in a hydronephrosis varies according to the underlying cause. It is highest in those in which there is incomplete obstruction because of secretion from the still intact parenchyma. The amount of fluid in such cases (Fig. 459) may reach one to two quarts.

COMPLICATIONS

Infection.

This may take place early or only in advanced cases. Aside from the gross turbidity of the fluid which results from infection, a variable number of pus cells and bacteria are found on microscopic examination. The clinical picture of renal infection in the form of fever, pyuria, etc., does not present any pathognomonic features in an infected hydronephrosis, the diagnosis of the latter only being possible after a urologic study.

Hemorrhage into the Sac.

The exact cause of minute or more extensive bleeding (hematonephrosis) is not quite clear. It may present clinically as a hematuria.

Spontaneous and Traumatic Rupture

R. M. Walker (Brit. Jour. Urol. 1933, 5, 159) up to the date of the report of a personal case found only five other cases of spontaneous rupture in the literature. Four of these were in adults and all gave a history of preexisting hydronephrosis. This had ruptured into the perirenal tissues. In Walker's patient, a man of 45, a sudden pain was felt in the right upper quadrant followed by generalized

abdominal tenderness and rigidity At operation, it was found that the fluid from the ruptured hydronephrosis had escaped through a tear in the posterior parietal peritoneum into the general peritoneal cavity

There appears to be a discrepancy in the number of cases of traumatic rupture of a hydronephrosis Scarby (*Acta Chir Scand* 1933, November, 361) in reporting a case stated that 70 had been previously published Peters (*Zeit Urol Chir* 1934, 39, 28) was only able to find 36 cases, including his own In some, the fluid remains in the perinephric tissues, in others, it also escapes into general peritoneal cavity The clinical picture is either (a) that of sudden, severe pain in the kidney region, shock and the development of a retroperitoneal mass or (b) severe sudden (localized) pain followed by symptoms of incipient peritonitis

FIG 462



FIG 462—Operative specimen showing extensive damage to kidney caused by blocking of outlet of renal pelvis by a relatively small oval calculus Note replacement lipomatosis around renal pelvis and upper ureter A small calculus is to be seen (right side of specimen) in a dilated calyx

FIG 463—Unusual urogram from case of left hydronephrosis and hydroureter



Nephrectomy has been successful in a number of early cases Cases of traumatic rupture have been recently reported by Haugseth (*Act Chir Sc* 1935, 76, 451), Robertson and Lee (*Urol and Cut Rev* 1934, 38, 243) In both cases, the patients were only ten years of age

SYMPTOMS

The clinical pictures under which cases of hydronephrosis of nontraumatic origin present are the following

1 Those with an abdominal tumor not accompanied by subjective symptoms i.e. silent cases

2 Those in which recurrent attacks resembling in every respect those described as ureteral or renal colics (see Chapter 31) and a permanent or transitory tumor is present

3 Those in which the symptoms of renal infection predominate

4 Those in which pain and hematuria are the principal features

Let us consider these briefly separately

1 **Silent Cases.** These are usually accidental findings during abdominal palpation. Their differentiation from other conditions giving rise to palpable enlargements, will be considered under the next clinical heading

2 **Pain and Tumor Predominate** There may only be a dull ache or a feeling of tension in the corresponding kidney region and the tumor be found during an effort to localize the origin of the pain. In a second and perhaps more common group of cases, there is a history of recurrent attacks of pain of varying severity and periodicity. The pain is of a severe colicky character as a rule. There may only be a history of one attack or of many dating back to infancy. It is more apt to be felt posteriorly i.e. over the iliocostal space and to radiate in a less typical manner (Fig 379) than is the case with colicky pain due to renal and ureteral calculi. It is often accompanied by reflex symptoms such as collapse, nausea, vomiting, abdominal distention, obstipation etc. In some cases there is a history of the appearance of an enlargement in the corresponding kidney region during the attack which may persist for some time after it. One is seldom able, however, to feel such a tumor during the attack on account of the reflex muscular rigidity of the abdominal wall. In other cases such an intermittent appearance of a hydronephrotic tumor is absent and one is able to palpate almost constantly a distinct mass which must be differentiated from all of the other renal conditions which can give rise to an enlargement as well as from other abdominal (intra peritoneal) tumors (see Chapter 43)

In some of the cases of intermittent hydronephrosis just described there is oliguria during the attack and a marked increase (polyuria) after it. The sudden block of the hydronephrotic side, and its reflex influence on the secretion of the opposite side explains this oliguria.

3 **Those in Which Symptoms of Renal Infection Predominate** Here the pyuria, fever, tenderness and evidences of generalized toxemia indicate a pyelonephritis. One finds such a picture in all three types of causes of hydronephrosis.

Infection of a hydronephrosis may occur by way of the bloodstream (hematogenous) or from the lower urinary tract (lymphogenous). In some cases (a) there are chills, high fever and more or less pain (constant) over the kidney. In others (b) there is a more latent course with pyuria and a moderate daily rise of temperature but high fever, chills etc. during the acute attacks. The latter are often the result of the secondary occlusion of the ureter by the overdistended pelvis (Fig 465)

4 Those in Which Pain and Hematuria Predominate Hematuria is never of the persistent type as seen in so many other renal conditions. It occurs in about 10 per cent of all hydronephroses as the result of congestion.

It most commonly accompanies or follows the pain of the recurrent attacks of acute blocking, described above under the name Intermittent Hydronephrosis. There may be hematuria as the only symptom according to Blatt (*Zeit Urol Chir* 1922, 2, 93).

DIAGNOSIS

This is based upon the following-

- 1 The clinical history
- 2 The urologic examination (including palpation of the abdomen)
- 1 Value of Clinical History

Pain As stated above, some cases run a symptomless course and attention is only directed to them by a persistent pyuria (see Chapter 47) or by finding an abdominal tumor. There is nothing characteristic about the dull or colicky pain in hydronephrosis, unless one can also feel an enlargement of the corresponding kidney, during or after the attack. Such a combination, as recurrent attacks of colicky pain and tumor, speak very strongly for an intermittent hydronephrosis.

Tumor This may or not be palpable. If so, it is round, smooth (usually) and has a tense elastic feeling. In advanced cases (with thin abdominal walls), distinct fluctuation may often be elicited. As a rule, the enlarged kidney is to be felt in the upper quadrant, but it may attain such a size as to extend beyond the median line or occupy the lower quadrant on the side from which it originates. One must never overlook the possibility of the hydronephrosis developing in a "dropped" kidney (Fig 455), i.e., in an abnormally mobile one as well as in a congenitally misplaced kidney (Fig 403), so that the location of the tumor will bear no relation to that of the normal kidney (Fig 15).

Hematuria This only occurs in 10 per cent of the cases and presents no features, which aid in distinguishing it from other sources of hematuria (Chapter 47).

2 Urologic Examination

This should always include in a more or less routine order, all of the procedures outlined in Chapter 10. One is not only interested in making a diagnosis of uni- or bilateral hydronephrosis, but also in attempting to ascertain the underlying causes. These include all of the forms of mechanical obstruction enumerated above, as well as an appreciation by the examiner, of the part played by a possible adynamic or toxic (infection), in the etiology of the ureteral or pelvic (renal) dilatation. A thorough examination of the urethra and bladder always precedes that of the upper urinary tract. There is nothing of diagnostic value in the appearance of the ureteral orifices. Even the observation that turbid urine or even thick pus escapes (efflux) from one or both orifices, is only of value when taken into consideration with the findings as elicited by ureteral catheterization, supplemented by ureteropyelography.

The Urine Of considerable value, is the observation that there is a continuous dropping of clear or turbid urine, as soon as the ureteral catheter is passed beyond the obstruction. The same is true of aspiration of the renal pelvis. In many

cases it is possible to obtain 100-200 cc. by this method. The catheter¹ in ureteral strictures, kinks or calculi will encounter a resistance or even complete block, in the majority of cases. Indigocarmine (or phthalein) will be eliminated very poorly on the hydronephrotic side (see Chapter 8 on Laboratory Methods).

Urography The most important method to visualize the size, location, probable etiology and emptying time of a hydronephrosis is urography. The



FIG. 464.—Operative specimen showing external appearance of kidney and postoperative urogram in a case of hydronephrosis of a bifid pelvis.

excretory method is valuable in yielding information as to all of the above. One of us recently (*Brit Jour Urol* 1935 7 124) called attention to two urographic features which are not as satisfactorily brought out by the excretory as by the other (retrograde) method. These are first imperfect visualization of the minor calices and second the probable type of mechanical obstruction. The degree of visualization of a hydronephrosis by excretory urography is dependent on two factors: the degree of occlusion if the cause is a mechanical one and the degree or extent of still functioning parenchyma. As to the former, the more complete the obstruction, the better the visualization provided that the hydronephrotic atrophy is not too advanced. If, as in the urogram shown in Fig. 463, there is very little

¹See examination for stricture of ureter in Chapter 30.

parenchyma remaining, there will be poor or complete absence of visualization. By the ascending (retrograde) method, we secure information as to the location and extent of the ectasis and better details (Figs 449 and 463) of the mode of union of the ureter and renal pelvis. It is especially useful in showing the presence of a filling defect due to vascular obstruction (Chap 17), ureteral neoplasms, strictures and calculi as mechanical causes.



FIG 465 —Urogram from case of right hydronephrosis and hydro-ureter

functional test and pyelogram indicate the presence of very little secreting tissue and finally is the obstruction of such a character as to permit of its being eliminated?

Let us consider these separately

1 Bilateral Hydronephrosis

This is usually accompanied by more or less ureteral dilatation and often by atony of the bladder which permits constant reinfection as the result of reflux (Fig 312 and Chapter 39). There is most frequently, some form of obstruction in the lower urinary tract of congenital or postnatal origin (such as urethral stricture, enlarged prostate, large vesical calculi, blocked ureters). These mechani-

Retention Test This is a very valuable method not only of determination of the location and degree of the obstruction, but gives one a conception of the ability of the renal pelvis and its calices to expel their contents. The majority of urologists depend upon serial plates taken at intervals of three up to fifteen minutes, after withdrawal of the ureteral catheter. If the fifteen minute film (Fig 457) still reveals the presence of a considerable amount of the opaque (pyelographic) medium, it is our practice to continue to make exposures at three minute intervals up to thirty minutes. The method is of especial value in obstruction or adynamic conditions of the renal pelvis (Fig 347). The normal emptying time is eight minutes and if this is extended to twelve or fifteen minutes, one should be suspicious of some obstruction in the upper urinary tract or enfeebled muscular power.

TREATMENT

This will depend upon the following

1 Whether the condition is a bilateral one

2 If unilateral, is there a complicating long standing infection, does the

cal causes of obstruction in the lower urinary tract should be eliminated if possible before beginning the treatment of the upper tract condition. One should be very conservative in the presence of bilateral dilatation of the upper urinary tract whether of obstructive or adynamic origin. The use of the inlying ureteral catheter, the treatment of any neurologic condition (spinal syphilis, tabes, etc.) and the administration of urinary antiseptics will often convert an apparently hopeless case into one in which the previously septic individual can resume his or her former occupation. Since we have used the inlying ureteral catheter for prolonged periods (weeks if necessary) there has been a marked improvement in many cases. Operative procedures on the kidneys are seldom indicated unless they be called for by the removal of obstructing calculi or fixation of an abnormally mobile kidney or temporary drainage of the renal pelvis when the use of the inlying ureteral catheter is impossible.

2. Unilateral Cases.

If the pyelogram, retention and functional tests indicate irreparable damage (Figs 463 and 465) removal of the kidney is indicated. If there is but slight infection present and the obstruction is due to an abnormal (lower pole) vessel one can try conservative measures such as reimplantation of the ureter, in preference to ligation of the vessel.

Every effort should be made in unilateral hydronephrosis to relieve the condition by plastic operations on the renal pelvis. The value of the different types and results of pyeloplasties will be discussed in Chap. 53 on Technic of kidney operations.

Cases of hydronephrosis due to neoplasms or tuberculosis are indications for nephrectomy. Papin has recently recommended denervation (see Chapter 53) for small painful hydronephroses but this method has not met with much favor. In a number of his cases nephropexy was also performed so that it is difficult to determine whether the improvement was not due to this.

Nephropexy should be considered in cases of abnormally mobile kidney with hydronephrosis unless (Fig. 455) the degree of ectasis is an indication for nephrectomy.

CHAPTER 37

SOLITARY RENAL CYSTS AND POLYCYSTIC KIDNEYS

TYPES

MINUTE
SOLITARY
PARAPELVIC
POLYCYSTIC

TYPES

The following types of cyst formation are found in the kidney

A Minute cysts, which are of no clinical interest are often observed in cases of chronic nephritis (Fig 466) They are very small, single or multiple and usually found on the surface of the kidney, less often deeper (See Fig 466)

B Solitary cysts These are encountered as

1 Solitary serous cysts (Figs 466 and 467)

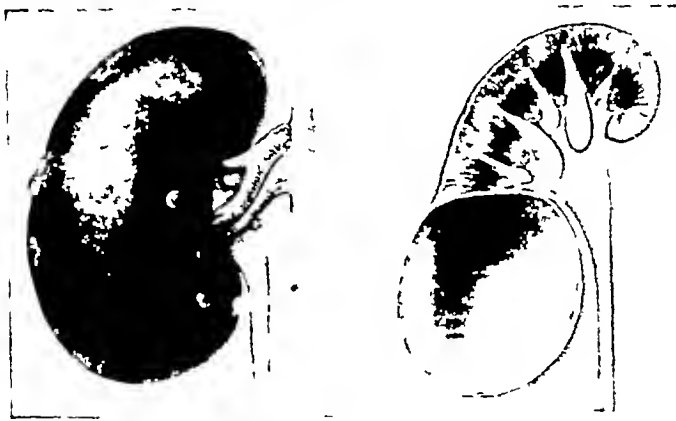


FIG 466 —In the left half of illustration, is seen a kidney with multiple minute retention cysts on its surface, which are of no clinical importance

In the right half a large solitary cyst is to be seen occupying the lower pole of the kidney but causing no displacement of the renal pelvis

2 Solitary hemorrhagic cysts

3 Multilocular cysts

C Parapelvic cysts

D Polycystic kidney

SOLITARY CYSTS

Solitary Serous Cysts

The only difference between the subgroup and the next one (hemorrhagic cysts) is in the contents of the cyst, i e , in one it is serous, in the other hemorrhagic

The number of reported cases of solitary serous cysts is much larger (over 300) than that of the hemorrhagic type (only 21)

Solitary serous cysts are usually unilateral, but they may occur in both kidneys They vary in size from that of a hazelnut to one containing 12 liters of fluid The average length, according to Smith and McKim (Jour Urol 1924, 12,

635) is 12 cm. They are more frequently found at the lower (Fig 466) than at the upper pole (Fig 467). The contents are serous; the interior of the cyst is lined by a layer of endothelium and the wall is in intimate contact with the adjacent parenchyma so that enucleation is at times very difficult.

In many cases there is no compression of the renal pelvis or its calices but in others (see urographic diagnosis) this is present to such an extent that the urogram closely resembles that of a neoplasm. Pressure on the adjacent upper abdominal hollow viscera such as the duodenum and colon has been reported.

FIG. 467



FIG. 468



FIG. 467—Large solitary cyst at upper pole of a kidney which was found in the iliac fossa (Fig 455). Note greatly dilated renal pelvis and kinking of ureter as secondary condition (case examined for Dr. C. E. Kahlke).

FIG. 468—Displacement of lower calyx and ureter by solitary cyst of lower pole.

At times solitary serous cysts communicate with a calyx or even with the renal pelvis as reported by Damm (Zeit. Urol. Chir. 1932 35 102) and by Quinby and Bright (Jour. Urol. 1935 33 201).

Solitary Hemorrhagic Cysts

Barney (Jour. Urol. 1936 36 602) added two personal cases to 19 previously collected by Munger. This type of cyst, as well as the serous type, is generally considered to be of congenital origin. The contents of the cyst in this subgroup (hemorrhagic cysts) is liquid or clotted blood depending upon how recently the hemorrhage has taken place. In one of Barney's cases the symptoms were so acute as to make it appear probable that the hemorrhage occurred shortly before the patient was seen. The gross and histological features as well as the size and location of hemorrhagic solitary cysts are the same as those of the serous type.

Multilocular Solitary Cysts

Only ten cases, including six observed at The Mayo Clinic have been reported according to Meland and Braasch (Jour Urol 1933, 29 505) They believe that they are of congenital origin They resemble solitary serous cysts in respect to their structure and location, being found chiefly at the upper and lower poles Reinecke (Virch Arch 1925, 254, 425) believes that such multilocular cysts are due to the fusion of several solitary cysts The number of cavities in the reported cases varied from 3-4 to several dozen (in two cases) As in solitary cysts there was a communication with a calyx in one case and with the renal pelvis in another

PARAPELVIC CYSTS

A typical case of this type was described by Haslinger (Wien Klin Woch 1926, 39, 534) In a patient whose clinical picture was that of an intermittent hydronephrosis, a cyst the size of the adult fist was found in close contact with the outer aspect of the renal pelvis It communicated with the pelvis by a minute opening It was considered as due to persistence of certain elements of the mesonephros

Symptoms and Diagnosis

NO CHARACTERISTIC SYMPTOMATOLOGY The symptoms and diagnosis of solitary (serous and hemorrhagic) multilocular and parapelvic cysts resemble each other so closely that they can be considered together As to the symptoms, there are none which are characteristic The urologic examination alone enables the diagnosis to be made in a larger proportion of cases of cysts located at the lower than when they are located at the upper pole of the kidney An analysis was made by Quinby and Bright (loc cit) of 36 cases of solitary cysts at the upper pole Over half complained of pain in the upper quadrant of the abdomen under the costal margin and in one fourth, the pain was referred to the back Gross hematuria was noted in 7 cases In two-thirds of the cases, neither the tumor nor the kidney were palpable Accurate pre-operative diagnosis of cysts of the upper pole of the kidney was only made in 2 of 36 reported cases In the cases in which urograms were made, the diagnosis usually was neoplasm of the kidney

In solitary and multilocular cysts located at the lower pole, palpation of a mass has often led to a urological examination

Excretory Urography A relatively large number of reports have appeared during the past fifteen years in which excretory or ascending urography or both have revealed deformities in solitary cyst cases greatly resembling those due to neoplasms There may be no change in the urogram to distinguish it from a normal one or there is marked deformity as follows

- 1 Displacement of a calyx alone and of the ureter or both (Fig 468)
- 2 Filling defects of one or more calices or of pelvis
- 3 Elongation and distortion of calices
- 4 Appearance of urogram as in a hydronephrosis

It will be evident that none of these are characteristic for solitary, multilocular or parapelvic cysts They are all found in neoplasms of the kidney, hence the frequency of erroneous diagnoses in these cases, both in cysts at the upper and lower poles In eight cases of solitary cysts at the upper pole, in which urography was employed, a displacement or deformity of the upper calices was noted in 6

In reviewing a large number of cases situated at other sites than the upper pole of the kidney Quinby and Wright (*loc cit*) found that in 41 cases, in which urography was recorded 34 or 83 per cent showed abnormal pyelograms. Danim (*loc cit*) reported five cases from the von Lichtenberg Clinic in all of which urography revealed changes which greatly resembled those due to neoplasms. That the latter may accompany a solitary cyst is shown by two reported cases one of a small hypernephroma reported by Ritter (*Am Jour Surg* 1930 8 1089) and one of a papilloma reported by Wells (*Brit Jour Urol* 1936, 8 22). In both the neoplasms was found in the interior of the cyst. For this reason Ritter advises opening every solitary cyst after removal.

Treatment.

This varies according to (a) the possibility of enucleation of the sac without serious damage to the kidney and (b) the amount of still intact parenchyma. Every effort should be made to save the kidney which can be accomplished in most cases with the aid of a relatively dry field during the enucleation and by accurate approximation of the denuded surface from which the cyst wall has been separated. To obtain a dry field during the enucleation of the sac some method must be employed to check the blood supply of the kidney temporarily without damage to the vessels of the pedicle. Many urologists use an ordinary nephrectomy clamp whose blades are covered by segments of rubber tubing. Very little compression is needed to control the bleeding. The clamp should never be closed completely but kept in the hands of an assistant who only approximates the blades enough to control hemorrhage. Other urologists employ a soft rubber catheter or rubber tubing (see Chap 53) which is placed one or more turns around the pedicle. The point of crossing of the limbs of the catheter or tubing are then clamped by an artery forceps.

Compression of the pedicle with the fingers is unsatisfactory because it is fatiguing if the enucleation is a difficult one. No matter how large the area of exposed surface of parenchyma after removal of a solitary cyst we have always found the use of the Beer Hagenbach method of closure (see Chap 53) adequate to close the defect. If the cysts are situated near the base of the papillae as in one of our cases or there is very little parenchyma left removal of the kidney is unavoidable.

POLYCYSTIC KIDNEY

(Multilocular Cystadenoma Congenital Cystadenoma)

Etiology

Various theories have been proposed to explain this not infrequent condition. The theories that it was the result of retention of secretion or that it was a neoplasm have been discarded in favor of the view to which Hildebrandt first directed attention and was later confirmed by Berner and others. According to this there is a failure of the two embryonic elements from which the permanent mammalian kidney is formed to unite. It will be recalled (Chap 1) that the ureteral bud grows into the renal blastema or metanephros (Fig 3) and after expanding to form the renal pelvis gives off the major and minor calices and from the latter through many divisions are formed the collecting tubules. These

should unite with the convoluted and other tubules which develop from the secretory cells of the renal blastema. A failure of these two portions to unite, is at present the most generally accepted explanation of the origin of congenital polycystic kidney.

Incidence, Age, etc

As to incidence, there are few necropsy reports. Preitz found only 16 polycystic kidneys in 10,000 necropsies or 1 in 625. A large number of clinical cases have been reported, the majority in patients between 40 and 60 years of age. Clinical symptoms are most likely to present during these two decades. Typical clinical cases in children have been reported by Baccarini (two under 3 years of age), Wakely (20 months old) and two in children 10 years of age by Maitland-Jones and by Halbertsma. Polycystic kidneys have been found in the fetus and in the new-born. The presence of very large polycystic kidneys in the fetus has been reported as causing dystocia.

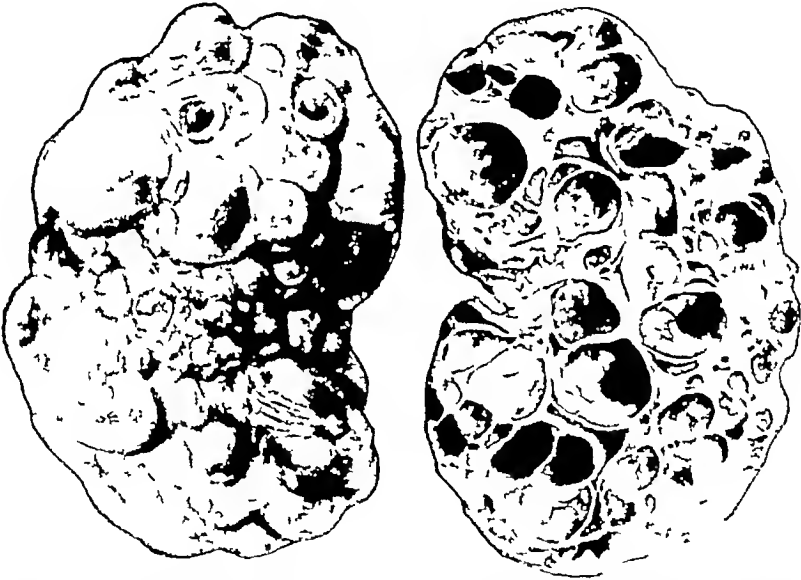


FIG. 460.—Drawing of necropsy specimen of typical polycystic kidney. Note almost complete replacement of parenchyma by the cysts, in sectional view (on right).

HEREDITY plays an important role. In two cases, included in the report of Braasch and Schacht (*Surg. Gynec. and Obst.* 1933, 57, 467), polycystic kidneys had been observed in three generations, and in five cases, in two generations. Fuss (*Zeit. Urol.* 1933, 27, 317) observed a case in which the father, sister and two brothers of the patient had the disease. In a case reported by Hofer (*Inaug. Diss. Bonn* 1931) bilateral polycystic kidneys and cysts in the liver were found in a new-born at necropsy. The same localizations were noted in the next child. The Wassermann reaction of the mother was negative.

Pathology

It is estimated that in 95-98 per cent of all cases, the polycystic disease is bilateral. Some deny that the disease is ever confined to one kidney, but that there is a variation in the stages of development in the two sides. That this can be detected urographically is shown in Fig. 471. Fahr (*Hbch. Path.* 1925, 6, 20)

cites a unilateral case observed by Wulff Lejars claimed to have seen three unilateral cases in 62 clinical cases Naumann reported having been able to find two unilateral and fourteen bilateral polycystic kidneys in 10 177 necropsies The kidneys usually retain their normal form but may be congenitally undeveloped (hypoplastic) or have two renal pelvises and two ureters on each side (case of Washburn) They may be even ectopic (found in true pelvis)

Polycystic Disease Associated with Solitary Cyst The occurrence of polycystic disease in one kidney and of a large (11 cm x 5 cm) solitary cyst on the opposite side is reported by Sternberg Two unusual instances of a solitary cyst and of polycystic disease in the same kidney were reported by Kleinschmidt one a personally observed case.

The largest polycystic kidney on record weighed 3500 Gm and was 30 cm in length That the polycystic disease may rarely be predominantly unilateral is shown in a case reported by Mursell (Brit. Jour Urol 1935 7 40) in which a patient upon whom nephrectomy was performed ten years ago is apparently well and able to do hard work.

THE INDIVIDUAL CYSTS VARY GREATLY IN SIZE (Figs. 469 and 470) They may be so closely packed together that very little parenchyma is to be seen on section of the kidney The surface of the kidney is a series of clear translucent hemispherical elevations formed by the cysts The contents may be liquid semisolid and clear or grayish-brown or yellow in color In about 6 per cent of all cases there are similar cysts in the liver (Fig 470) and in a lesser percentage in the pancreas Of 9 necropsies at The Mayo Clinic in cases of bilateral polycystic kidney cysts were also found in the liver in four and in the pancreas in one

Associated diseases which complicate polycystic kidneys will be considered under Treatment.

Clinical Pictures.

Cases of polycystic kidney as encountered clinically can be divided into the six following groups.

GROUP ONE LATENT CASES I.E. SYMPTOMLESS In this group the polycystic kidneys liver and pancreas are accidental findings at necropsy or during an operation for other abdominal conditions

GROUP TWO CLINICAL PICTURE OF CHRONIC NEPHRITIS The majority of

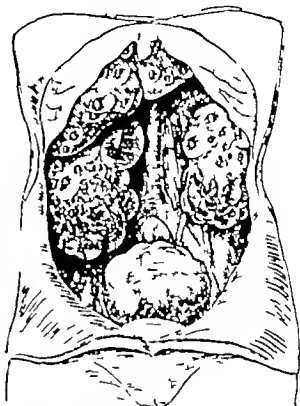


FIG 470—Case illustrating occurrence of bilateral polycystic kidneys and same condition in liver (latter found in 6 per cent of cases of polycystic kidneys)

The urogram (bilateral) of this case is shown in Fig. 471 Patient also had large uterine fibroid.

the patients in this group are between 40 and 60 years of age when the symptoms appear, but cases have been reported in which this occurred in children and in young adults, so that the possible existence of polycystic kidneys must always be borne in mind when a patient presents one or more of the following symptoms or findings

(a) **RISE OF BLOOD PRESSURE** 29 of 49 cases reported by Oppenheimer (Ann Surg 1934, 100, 1136) had over 160 mm Hg systolic pressure and a similar rise was noted in 61 per cent of the cases reported by Braasch and Schacht (loc cit) who found that the blood pressure rises as the disease advances

(b) **INCREASED BLOOD-UREA CONTENT** 20 of 45 cases (Oppenheimer) had a marked increase as an evidence of retention of nitrogenous waste products in the blood. The blood urea was normal in only one third of Braasch and Schacht's cases

(c) **DECREASE IN ELIMINATION OF DYES BY THE KIDNEY** This was noted as below normal in two-thirds of the cases by Braasch and Schacht

(d) **CHANGES IN THE FUNDUS OF THE EYE** These resemble in every respect those seen in chronic nephritis

(e) **SYMPTOMS OF MINOR RENAL INSUFFICIENCY** such as headache, nausea, anorexia, etc

RESEMBLANCE TO OTHER DISEASE It is evident that the above clinical picture does not differ as to the subjective symptoms and objective findings from that of a nephrosclerosis or chronic interstitial nephritis. A glance at a section of a polycystic kidney (Fig 469) will show how the parenchyma is steadily but unceasingly subjected to pressure atrophy by the development of the cysts, with suppression first of the function of the tubules and last of the glomeruli. Many of the cases in this group are seen in coma or, at least, presenting the clinical picture of a uremia, the diagnosis of the underlying cause often only made at necropsy

In a case presenting any or all of the symptoms or objective findings just enumerated, the diagnosis should be completed by palpation of the kidney and urography (see below)

GROUP THREE SYMPTOMLESS HEMATURIA CASES Gross hematuria was noted in one third and microscopic evidence of bleeding in 43 per cent of the cases reported by Braasch and Schacht. It may appear relatively early and be the only symptom as in the case whose urogram is shown in B of Fig 471. The hematuria cannot be distinguished without a urological study from hematuria due to many other systemic or renal causes as discussed in Chap 47. The bleeding is due to congestion or rupture of the cysts in close relation to the renal pelvis. It varies in amount and duration, appearing suddenly, and may never recur or it does so at shorter or longer intervals with or without (more commonly) accompanying colicky pain, due to passage of clots through the ureter. The diagnosis of the source of the bleeding being due to polycystic kidneys is made as in the preceding group by palpation and urography

GROUP FOUR DISCOVERY OF ENLARGED KIDNEYS This may occur during routine palpation in the differential diagnosis of various abdominal conditions or in the search for the source of a hematuria. The enlargement of the kidney may be uni- or bilateral, more frequently the former. Quite often as in the case shown in Fig 470 the surface presents on palpation a series of soft nodules, varying

greatly in size. The diagnosis of the cause of the enlargement can only be made with the aid of urography.

GROUP FIVE. PAIN THE CHIEF SYMPTOM As a rule, the pain is of a dull aching character referred to an upper abdominal quadrant or to the back. It is seldom severe unless some complication exists such as a coincident calculus or infection. The pain may be the only symptom to draw the attention to the kidney as its source.

GROUP SIX. COMPLICATIONS AFFECT CLINICAL PICTURE. Cases in which the clinical picture is due to some complication such as (a) Acute and chronic pyelonephritis (b) perinephritic abscess (c) urolithiasis (d) ptosis (e) tuberculosis



FIG. 471.—Pyelograms from two cases of polycystic kidneys.

A. Symptoms of acute renal infection and palpable tumor (right). Note bizarre distortion of pyelograms on both sides. (Compare with Fig. 473.)

B. Chief symptom moderate hematuria. The pyelograms reveal the presence of the disease in both kidneys by the marked elongation of the pelvis and calices. Polycystic condition not as advanced as in A.

as in Vintici's case and (f) neoplasm with or without hydronephrosis. Of these calculi and infection occur most frequently as complications.

It is superfluous to reiterate the more common clinical pictures of these various complications but it is well to bear in mind that they may dominate to such an extent that at least in the acute complications, the discovery of a polycystic kidney is only made at operation.

Diagnosis

DIAGNOSTIC DATA FURNISHED BY A UROLOGICAL EXAMINATION The results of palpation in advanced cases have been described under Group Four but there are other cases in which palpation is negative. If one suspects the presence of polycystic kidneys, the routine examination should always include search for all

of the data mentioned under Group One The drop from the normal in the elimination of dyes, such as pthalein and indigocarmin, is especially valuable in summing up the evidence in favor of the presence of polycystic kidneys

UROGRAPHY Of all of the objective methods, urography is the most valuable one, for diagnostic purposes The urographic changes may be less marked in early than in more advanced cases In the early stages, a hardly noticeable elongation and narrowing of the major calices is seen In the more advanced cases, the bizarre character of the elongation and compression of both major and minor calices, has given rise to the term "dragon" deformity There are other changes in a large proportion of polycystic kidney urograms which aid in distinguishing them from deformities of the pelvis and calices in neoplasms These are (a) the normal cupping (Fig 472) at the ends of the minor calices is either intact, (b) the tips of



FIG 472—Marked "dragon like" deformity in left pyelogram (right half of illustration) Note incipient changes in opposite (right) pyelogram

these minor calices are flattened (B of Fig 471), or (c) expanded in a peculiar way (A and B of Fig 471) The changes are seen in both kidneys at the same stage (Fig 471) or at different stages of development (Fig 472)

In advanced cases, the ureter shows varying degrees of mesial or upward (cephalad) displacement This, however, is not a distinguishing feature, as the same change may be observed in both renal and pararenal neoplasms (see Chap 43)

Of the two methods, excretory and retrograde urography, the latter is to be preferred, first because it gives better visualization of the minor calices and second, because there may be so little functioning parenchyma left, that but little of the iodine in the intravenous medium is excreted, so that visualization is poor In cases with high blood urea, hypertension or poor elimination of dyes, it is advisable not to attempt a bilateral retrograde urography at the same sitting and then only to use the same preparations as are employed at present for excretory urography but in more dilute solution (see Chapter on Radiography)

Treatment

Cases of polycystic kidney, so far as treatment is concerned, fall into two groups

GROUP ONE THOSE IN WHICH OPERATION IS INDICATED because of some complication There can be no question that the indications for nonoperative or operative treatment of such complications as calculi acute and chronic infection of the kidney as well as perinephritic abscess should not differ from the treatment called for in kidneys in cases in which no polycystic disease exists The utmost conservatism should however be our guide unless a radical measure such as nephrectomy is imperatively necessary This should never be done until the degree of development of the polycystic changes has been evaluated If the blood urea is high, dye excretion poor and urography shows fairly advanced polycystic changes in the opposite kidney nephrectomy is almost certain to be followed by evidences of renal insufficiency or anuria.

GROUP TWO POLYCYSTIC KIDNEYS WITHOUT COMPLICATIONS Here the operative indications may be (a) severe bleeding (b) severe pain (c) threatening uremia.

Three types of operation are at present employed in uncomplicated cases of polycystic kidneys They are first, the Rovsing operation which consists in puncturing as large a number of cysts as possible on the surface, with a cautery or high frequency needle second an operation in which the large cysts on the surface are opened and the walls of many excised followed by splitting the kidney but avoiding opening any calices as suggested by Goldstein (*Jour Urol* 1935 34 536) and third nephrectomy Lazarus (*Urol and Cut Rev* 1934 38 457) even advises the Rovsing operation for both kidneys. Walters and Braasch (*Surg Gyn and Obst.* 1934 58 647) reported a series of 31 nephrectomies and 29 Rovsing operations. They consider a blood nitrogen retention of more than 60 mg per 100 cc as a contraindication to operation. Briefly the indications according to Walters and Braasch for any type of intervention are (a) bleeding (b) pain (c) localized or diffuse infection and (d) calculi neoplasms tuberculosis, hydronephrosis Their conclusions are that the end result of the Rovsing operation cannot be determined as yet and that secondary nephrectomy may be necessary because of persistent fistula formation or infection

CHAPTER 38

SYPHILIS, ACTINOMYCOSIS AND ECHINOCOCCUS OF THE KIDNEY

SYPHILIS

SYMPTOMS, DIAGNOSIS AND TREATMENT

ACTINOMYCOSIS

INCIDENCE AND PATHOLOGIC CHANGES IN THE KIDNEY

SYMPTOMS AND DIAGNOSIS TREATMENT

NON-ACTINOMYCOTIC INFECTIONS

ECHINOCOCCUS OF THE KIDNEY

LOCATION AGE AND COMPLICATIONS SYMPTOMS AND DIAGNOSIS

SYPHILIS

The most frequent type of involvement of the kidney is that in which the pathologic changes and symptoms are the same as those of nonsyphilitic nephritis. They resemble each other so closely that in the absence of a history of syphilis and the presence of a positive Wassermann, it is impossible to distinguish a specific from a nonspecific nephritis.

Of greater urologic interest are the two less common forms of renal syphilis. These are

(a) Gummata, i.e., circumscribed nodules

(b) Gummatous infiltrations and diffuse syphilomata. The former (Gummata), usually appear as nodules varying in size from a lentil to that of a cherry, rarely larger. They are more frequently found in the cortex than in the medulla, but may occur in both at the same time. They give rise to prominences on the surface of the kidney which are of yellowish or grayish-yellow color. They may be single or multiple, uni- or bilateral. On section, the surface is quite dry and firm, although the larger ones may become soft. Gummata occur comparatively rarely. Gummatous infiltrations and diffuse syphilomata are more apt to involve the fibrous and fatty capsules, resulting in marked thickening and edema of the perinephritic tissues. In course of time, radiating scars develop from the syphiloma or localized gumma, whereas the more diffuse form ends in marked thickening and retraction of the peri- and paranephritic fat.

SYMPTOMS, DIAGNOSIS AND TREATMENT

If the symptoms resemble those of a nonsyphilitic nephritis, it is impossible to make a diagnosis of nephritis of syphilitic origin unless the clinical history is that of this type of infection and the Wassermann and similar reactions strongly positive. The urine in such cases may contain only albumin and casts unless a gumma undergoes softening and is discharged into the pelvis. Under these conditions, blood and pus are found in the urine according to Boshamer (*Zeit. Urol. Chir.* 1936, 42, 48) who also states that, at times, the gummata may be large enough to palpate, but even so, there is nothing to distinguish them from a neoplasm, in the absence of a clinical history or specific reactions indicating a syphilitic origin.

The treatment of a syphilitic nephritis or of gummata does not differ from that of the disease in its other localizations. Especial care should be taken (Boshamer) to avoid giving mercury and iodine, because of the accompanying nephritic changes.

ACTINOMYCOSIS

Description Filamentous organisms¹ with characteristics that relate them both to the ordinary bacteria and to the moulds have been found in a variety of pathologic processes in man and the domestic animals. In lesions in the animal body the typical picture of a granule is that of a filamentous mycelial core surrounded by radiating clubs (Fig 473) whence the name ray fungus (actinomyces)

Actinomycosis is essentially a suppurative process characterized by the formation of granulation tissue and by the presence in the pus of peculiar granules. The latter on microscopic examination are seen to be dense rosettes of club-shaped filaments with the definite radial arrangement which has suggested the name of ray fungus.



FIG. 473—Colony of *Actinomyces* with well-developed clubs at the periphery found in a nodule in the peritoneal cavity of a guinea pig inoculated with a culture from another guinea pig. Paraffin section. Low magnification (Wright) (Photography by Mr. L. S. Brown. Courtesy Wright and Jour. Med. Res., 1904.)

cortical abscesses or a sharply demarcated tumor like firm nodule about the size of a plum. On section such a nodule presents the appearance shown in Fig 474 of a number of discrete and confluent yellowish areas arranged in groups and imbedded in fibrous tissue having a waxlike appearance. The nodules are sharply demarcated from the surrounding parenchyma.

The most common location of an extrarenal focus which invades the kidney by extension along the retroperitoneal tissue is in the cecum.

SYMPTOMS AND DIAGNOSIS

There are no characteristic symptoms which enable a differential diagnosis to be made of an actinomycotic from other types of acute and chronic pyelonephritis.

The description of the morphologic characteristics is taken from the book on General Bacteriology by E. O. Jordan where excellent illustrations can be found of this parasite as it appears in tissues and in cultures.

unless the actinomyces are found in the urine This only occurred in four published cases

In all of the published cases in which urography was employed, the changes in the contour of the renal pelvis and its calices resembled so closely those observed in neoplasms as to lead to an erroneous diagnosis In Abbott's case (*Jour Amer Med Ass'n* 1924, 82, 1414) there was a deformity of the spider type In Cumming and Nelson's two cases (*loc cit*) the urogram revealed a displacement of the ureter and a filling defect of the renal pelvis as seen in neoplasms in the first case and multiple areas of ureteral narrowings with pyelectasis in the second case In Moore and Tapper's case (*loc cit*) there was evidence of ureteral obstruction just below the renal pelvis, hence a pre-operative diagnosis of ureteral

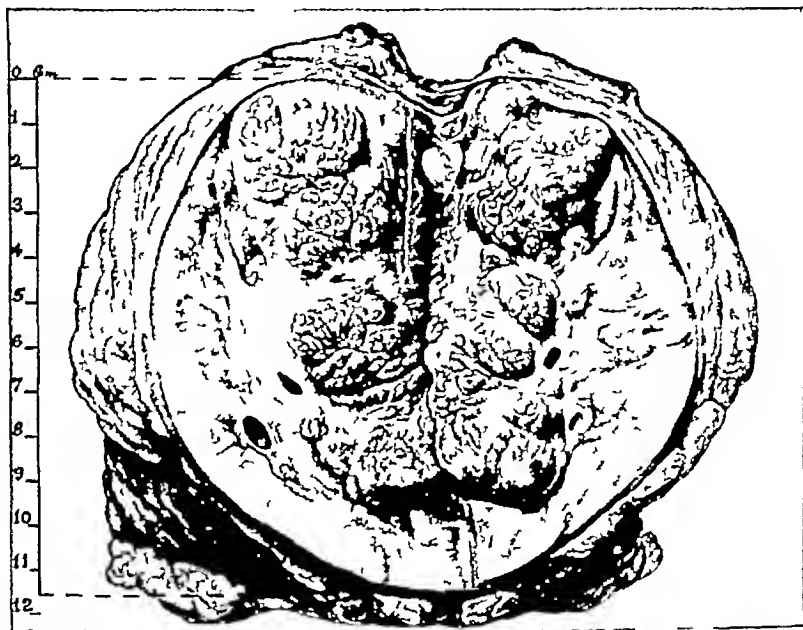


FIG 474—Extensive involvement of kidney by actinomycosis Note resemblance to nodular form of renal tuberculosis (Kindly loaned by Dr R E Cumming)

obstruction of undetermined etiology was made If the perinephritic tissues are involved as the result of extension from the kidney or from some extrarenal focus (most commonly the cecum) there is a board-like induration around the kidney with formation of multiple minute or larger abscess and the escape of pus through fistulae usually located in the kidney region but often further away In every case of suppurative perinephritis of long standing with fistula formation, the pus should be examined for actinomyces Extension to the spine and coverings of the spinal cord was noted in Abbott's case

A concomitant infection with the ordinary pyogenic bacteria, especially the staphylococcus, make pre-operative diagnosis very difficult, especially when the symptoms of acute pyelonephritis like a dull aching pain over the kidney, fever, chills and frequency of urination dominate the clinical picture as in Moore and Tapper's case In this case, the actinomyces were found in the pus of a fistula

TREATMENT

This must vary with the pathologic changes found at operation If the actinomycosis is apparently limited to the kidney, i.e. has not extended to the

fatty capsule nephrectomy is indicated. If there is involvement either by extension from a primary focus in the kidney or a focus in some other adjacent structure (cecum, colon, etc.) free drainage should be established until such a time when the primary focus can be eliminated. In the interval, radltherapy and medication is to be recommended in the form of copper sulphate one-fourth grain three times daily by mouth and irrigation of the wound with a 2 per cent solution of the same salt at least once a day, as suggested by Bevan. Some prefer large doses of iodides up to 150 grains daily.

NON-ACTINOMYCOTIC FUNGUS INFECTIONS

Although actinomycosis is the commonest type of fungus infection, eight cases of non-actinomycotic fungoid disease of the kidney have been reported. Seven of these are included in an article by C. W. Lundquist (Brit Jour Urol 1931 3:1) one personal observation and six cases reported by others.

The latter included one of sporotrichosis, three of *Oidium albicans*, one of *Cryptococcus renalis* and one of *Fusarium*. Lundquist's report is based on the study of a kidney removed for pyonephrosis. A mixed infection by the bacillus coli and a fungus belonging to the *Oidium* species was found. The eighth case is that reported by Wegelin (Zeit Urol Chir 1933 36:281). The kidney on gross examination resembled the changes seen in caseous tuberculous. The fungus found belonged to the aspergillus type of fungi.

ECHINOCOCCUS OF THE KIDNEY

It was formerly believed that this was a relatively rare localization, but we have been able up to Oct. 1, 1937, to find reports of 245 clinical cases. In several reports no distinction is made at least in accessible abstracts between Echinococcus of the kidney itself and those found in the adjacent retroperitoneal tissues, but as only 16 cases are involved this does not greatly diminish the 245 reported cases. It is of interest to note that in certain countries where Echinococcus disease is very prevalent, two authors report 33 and 36 cases respectively from North Africa, one a series of 18 from Australia and still another 12 from Dalmatia, all personally observed. The incidence of Echinococcus of the kidney to other localizations in these reports varied considerably, as follows: 1 in 107, 3 in 114, 2 in 100, 10 in 215, 5 in 30, 4 in 109. All of these are personally observed localizations so that they have more value, we believe, than larger statistics from various sources which cannot all be controlled.

LOCATION, AGE AND COMPLICATIONS

As a rule only one kidney is involved. When the disease is bilateral the evolution is more advanced on one side than on the other. In the majority of cases there is only a single cyst containing a number of daughter cysts. This was true of 8 out of 12 cases reported by Racic (Zeit Urol 1934 28:292) while in the others the entire kidney was filled with cysts. When the cyst is single it is most commonly found in the cortex at the upper or lower pole, but develops in the direction of least resistance, i.e. toward the renal pelvis. This explains why scolices, small cysts and shreds of the bluish membrane are found at times in

the urine, especially after an injury to the kidney. Perforation into the perirenal space is rare. One case is reported in which the cyst was subcapsular.

As to age, the disease is most commonly seen in adults, but its occurrence in children is not excluded. A case is reported by Alterescu (Abstracts Zeit Urol Chir 1935, 40, 203) of *Echinococcus* of the kidney which presented the clinical picture of an acute pyelonephritis. The diagnosis was made by finding all of the above cited evidences of the disease in the urine.

Complications The existence of two other localizations of *Echinococcus* is of such importance in the diagnosis of that of the kidney, that they deserve mention. These two unusual, but clinically important localizations are first, in the perirenal tissue and second, in the psoas muscle so that pressure is exerted on the ureter. Stricker (Zeit Urol Chir 1924, 15, 50) reported a case of the former and

collected 11 others. In his case, a large *Echinococcus* cyst was so adherent to the lower pole of the left kidney, that the pelvis and lower calyx were pushed upwards as seen in the urogram, thus simulating a solitary cyst of the lower pole. A number of cases of perirenal *Echinococcus* have been reported since Stricker's article appeared. As to the second atypical localization, a case is reported by Pigeon and Bernasconi (Jour d'Urol 1927, 24, 174) in which an *Echinococcus* cyst in the psoas muscle exerted pressure on the overlying ureter to such an extent as to cause both ureterectasis and pyelectasis above the point of obstruction.

Calcification of the cyst wall is frequently mentioned and was of aid in making a preoperative diagnosis in several cases.

SYMPTOMS AND DIAGNOSIS

If infection supervenes, the clinical picture is changed considerably.

As in the case of syphilis and actinomycosis, so in *Echinococcus* of the kidney

there are no specific symptoms or objective findings.² In certain countries where *Echinococcus* is very prevalent, e g, Dalmatia, one will always think of this disease when the kidney is the seat of a cystic tumor.

Pain of a dull aching character is perhaps the most constant symptom. The presence of a mass in the kidney region with a smooth, firm surface and accompanied by frequency of urination, is present in so many renal conditions, as to afford little aid in the diagnosis of a possible echinococcus. In the same category, belong the deformity seen in a urogram and also symptoms of acute or chronic renal infection. The finding of hooklets, or of daughter cysts or portions of the cyst wall in the urine is, of course, pathognomonic. One must always bear in mind



FIG 475—Retrograde urogram in a case of *Echinococcus* of the kidney. Note filling defect in upper calyx and displacement downward with associated deformity of the middle and lower major calices (Courtesy of Dr Joseph Tenenbaum)

² Unless one finds hooklets or portions of a large cyst or an entire daughter cyst in the urine.

however that some extrarenal focus may have ruptured into the urinary tract. Severe colicky pain simulating that of ureteral calculi and analogous conditions is a prominent feature during the passage of daughter cysts.

The complement fixation test is of value but it is not infallible. It is positive in about eighty per cent of the cases. Cason's intradermal reaction is also positive in the majority of cases. It may be negative when the parasites are dead or secondary infection supervenes.

In the early stages when the cysts are not very close to the calices or pelvis, urography is of little diagnostic value. Later, one finds (a) either calcification in the wall of the cyst which has enabled a correct preoperative diagnosis to be made or (b) the enlarging cysts encroach upon the pelvis or its calices giving rise to filling defects or distortions (Fig. 475) of the contour of the calices or the pelvis like those seen in neoplasms.

A pre-operative diagnosis has been made in a number of cases by the following methods:

1. Finding scolices, cysts or portions of their lining membrane in the urine.
2. By plain radiography, calcified edges of cysts.
3. By urography (filling defects, distortion of calices, displacement of pelvis or ureter) in 9 cases.
4. By observing protrusion of a cyst from the ureteral orifice (Blum).

TREATMENT

This varies with (a) the degree of pressure atrophy of the renal parenchyma and (b) the possibility of enucleation of the cyst. If there is almost complete destruction of the kidney, nephrectomy is indicated. If the cyst can be enucleated this is the ideal method, the raw surface being swabbed with a 10 per cent formaldehyde solution. If it is impossible to enucleate and the kidney can be saved as much of the sac should be excised as can be easily done and the rest marsupialized after irrigating with a strong formaldehyde solution.

NONTUBERCULOUS INFECTIONS OF THE KIDNEY

BACTERIOLOGY
 ROUTE OF INFECTION
 PATHOLOGY
 ACUTE CHANGES IN PYELONEPHRITIS
 CHRONIC PYELONEPHRITIS
 CLINICAL PICTURES AND DIAGNOSIS
 ACUTE CASES WITHOUT AND WITH LOCALIZING
 SIGNS

CHRONIC CASES WITHOUT AND WITH LOCAL
 IZING SIGNS
 TREATMENT OF HYPERACUTE AND ACUTE PYE
 LONEPHRITIS
 TREATMENT OF CHRONIC PYELONEPHRITIS

Some of the less frequent types of nontuberculous infection have been discussed in the preceding chapter. In this one, the clinical aspects of the more common types will be taken up.

BACTERIOLOGY

For clinical purposes, the most convenient division of the bacteria concerned in renal infection into Gram negative and positive is based on their behavior when the Gram stain (Chapter 8) is used for staining (see Plates III and IV) smears of the centrifuged sediment of urine, of pus or for identification of bacteria in sections of tissue.

The most common Gram negative are
Escherichia coli (*B. coli communis*)
Bacillus lactis aerogenes (aerobacter)
Bacillus proteus
Bacillus pyocyaneus
Gonococcus and *Micrococcus catarrhalis*
 Less common are
 Typhoid and paratyphoid bacilli

The most common Gram positive are
Staphylococcus aureus and *S. albus*
Streptococcus
 Less common are
Pneumococcus
Micrococcus tetragenes
Enterococcus

We will not attempt to give the methods of identification of these various groups, as these are so well covered in all of the standard text books of bacteriology.

Gram Negative Bacteria

B. coli Group The two types which are of most clinical interest, so far as renal infections are concerned, are the *B. coli communis* or *Escherichia coli* as it is termed, and the *B. lactis aerogenes* or *aerobacter*. These two are found in from 60-75 per cent of all urinary infections. There are more than 75 strains of *B. coli* which grow over a wide range of titer, viz., pH 5.0-8.0, but are only killed at pH 4.6 on the acid and pH 9.6 on the alkaline side.

A little further on, under treatment, the clinical application of these observations first to *B. escherichia*, then to other bacteria found in urinary infections, will be taken up.

The *aerobacter* is more resistant to modifications of the pH of the urine and to medication than the *Escherichia coli* which it resembles very closely in its cultural characteristics. According to Jordan (Bacteriology 1935 edition), the *Bact. aerogenes* (*aerobacter*) may be distinguished from *Bact. coli* (*Escherichia*)

by three tests (1) Methyl red test, (2) Voges-Proskauer reaction and (3) Sodium citrate medium. The *Bact coli* (*Escherichia*) does not grow on this last named medium.

The *Bacillus proteus* belongs to the group of urea-splitting bacteria. It has been found in infections limited to the urogenital tract as well as in bacteriemias which had their origin there. MacKenzie and Hawthorne (Jour Urol 1933 30 277) found 17 reported cases of *B proteus bacteriemia* of which five were fatal. In their own case the blood culture was positive for *B proteus* before a nephrectomy for pyonephrosis and the same organism was found in pure culture in the specimen. E. F. Hirsch and D. Shapiro reported a case in which two blood cultures were positive before nephrectomy. The specimen showed an intrinsic thrombophlebitis (renal) as a complication of an ascending infection from the prostate and bladder.

B pyocyaneus although less frequently found in kidney infection than the three above mentioned bacteria can give rise to both local (urogenital) and systemic infection.

Gonococcus infections of the kidney are comparatively rare. Uhle (Jour Urol 1934 32 335) found only 12 reported cases which had been verified, i.e. that the gonococcus was found in smears, cultures and in fermentation tests in the ureteral urine. Uhle added a thirteenth personally observed case and Sisk and Wear (Urol and Cut. Rev. 1936 41 390) reported a fourteenth case.

Typhoid and paratyphoid bacilli are found in the urine in 20-40 per cent of patients suffering from these infections and may give rise to the same pathologic changes in the kidney and clinical pictures as other members of the colon typhoid group of bacteria.

Gram Positive Bacteria.

Staphylococci. This group is considered to rank second in the order of frequency of renal infection, those due to the two members of the *B coli* being placed in the first rank. Young, Colston and Hill (Jour Amer Med Assn 1932 98 715) found that staphylococci were found nearly as frequently as the *B coli* group. Campbell (Pediatric Urology 1937 1 392) states that in a series of children with chronic pyuria staphylococci were found in smears in 43.6 per cent and in pure culture in 25.9 per cent.

In many cases of renal infection the staphylococcus is the primary and the *B coli* or others of the Gram negative bacteria, the secondary invaders.

The incidence of staphylococci is especially high in hematogenous infections of the kidney. Both the aureus and albus types are found, the former more often. According to Hellström both play an important part in the formation of renal calculi.

Certain strains of *Staphylococcus albus* have marked urea-splitting properties without being pathogenic.

Streptococci. As is true of the *B coli* and *Staphylococcus* groups of bacteria, both hemolyzing and nonhemolyzing types of streptococci are found in kidney infections. The hemolyzing variety is the more virulent. Certain strains of streptococci have been found to have a selective affinity for the kidney. Hemolytic streptococci play an important part in acute and chronic nephritis, in which hematuria is the outstanding clinical symptom according to Winkenwerder.

McLeod and Baker (Arch Int Med 1935, 56, 297), the atrium of infection being in the tonsils, pharynx, bronchi and lungs (pneumonia)

The incidence of streptococci in urinary infections is about 15 per cent

The other Gram-positive bacteria enumerated above are much less frequently encountered in renal infections

An interesting case was reported by Mathé and de la Pena (Urol and Cut Rev 1934, 39, 78) of pneumopyelonephrosis in which gas formation had taken place. Only *B. coli* and staphylococci were found by culture, no gas formation being noted in media used to detect anaerobic bacteria

ROUTE OF INFECTION

1 Hematogenous Route

Bacteria enter the kidney by way of its blood vessels more frequently than by any of the three other routes to be described below. Coccal infections almost invariably reach the kidney by the hematogenous route. Whether bacteria of the *B. coli* group enter the kidney in the same way is still under discussion. Some urologists like Heitz Boyer maintain that *B. coli* pass through the wall of the colon and are carried to the kidneys by way of the systemic circulation. Experimental studies show that this may be true of cases in which ulcerative changes have taken place in the mucosa of the bowel but that it does not occur under normal conditions. The atria of infection in coccal infections are (Fig 476) the tonsils, teeth, upper respiratory tract, skin, prostate, seminal vesicles. That *B. coli* can enter the general circulation and then the kidney is shown by the reac-

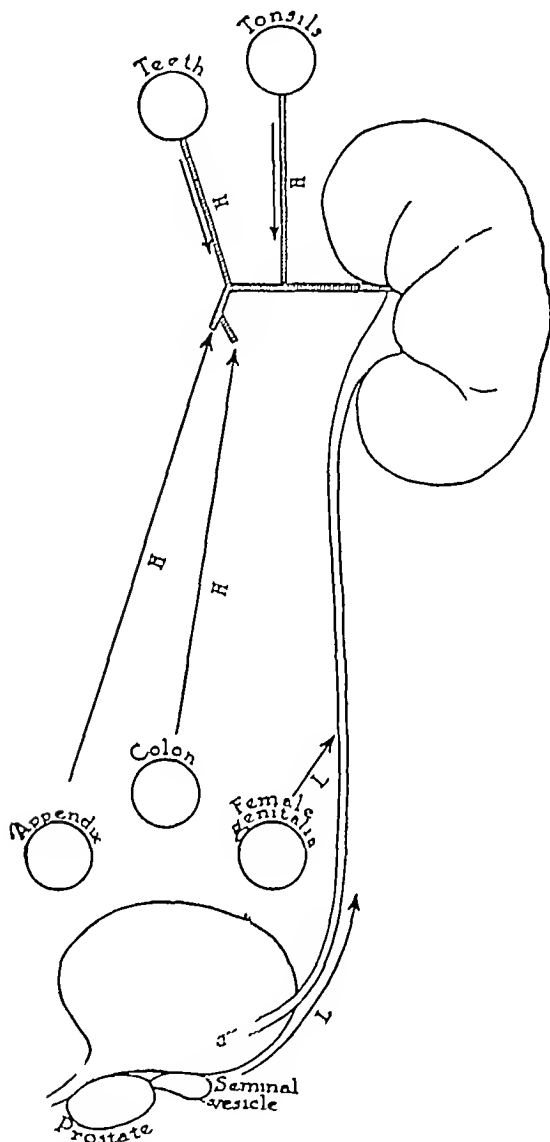


FIG 476.—Diagram of routes of infection in hematogenous and lymphogenous nontuberculous pyelonephritis. Note possible foci in tonsils, teeth, colon and appendix in hematogenous, and in seminal vesicle, prostate, female genitalia, bladder and urethra in lymphogenous infections

tion following urethral instrumentation, e.g., passage of sounds, transurethral resection, etc., as revealed by blood cultures in patients presenting symptoms such as chills, fever and other evidences of entrance of bacteria into the general circulation. Scott (Jour Urol 1929, 21, 527) found that the bacteriemia was bacillary in 77 per cent and coccal in 23 per cent of 82 cases. *B. coli* were found in 40 per cent

2 Urogenous Route

This means, strictly speaking, that the bacteria reach the kidney by way of the column of urine in the ureter. Under normal conditions, it is difficult to

visualize how even motile bacteria could resist being carried toward the bladder by the peristaltic action of the ureteral musculature on the column of urine. Even under pathologic conditions which cause stasis such a mode of upward progression could only be conceded for very motile bacteria. It might happen that in cases of complete ureteral block (see Chapter 31) the entire column of urine



FIG. 477.—Typical findings in case of bilateral reflux. 150 cc. of a 25 per cent sodium bromide solution was injected into bladder in case of pyuria of long standing. Note how opaque medium fills dilated ureters and pelvis as result of reflux (see text)

contains actively proliferating bacteria. In general the urogenous route is at present regarded as of much less importance than formerly except in patients in whom a ureterovesical reflux (Fig. 477) exists.

Normally regurgitation or reflux of bladder contents is prevented by a valve-like mechanism at the vesical end of the ureter as well as by the oblique course of the intramural portion of the ureter. Under certain pathologic condi-

tions, when the detrusor contracts, the bladder urine not only escapes through the urethra but is forced upwards into one or both ureters. This mode of transmission of infection to the kidney is seen (a) in neurogenic dysfunction of the bladder (Fig 478), (b) in chronic nontuberculous and tuberculous cystitis, (c) in large bladder calculi and (d) in many cases of bladder-neck or urethral obstruction. In some patients, the gaping (Fig 479) ureteral orifices, as seen at cystoscopy, is indicative of the existence of vesico-ureteral reflux even before cystography (Fig 479) confirms the diagnosis.



FIG 478—A Right sided reflux in man of forty with cerebrospinal syphilis and severe renal and vesical infection. Note size of tonic bladder in cystogram.

B Marked bilateral dilatation of the renal pelvis which persisted after acute infection had been greatly improved by use of indwelling ureteral catheters (see text).

C One year later. Absence of reflux. Capacity of both renal pelvises one tenth former amount. Marked general improvement. (Courtesy Jour of Amer Med Assoc.)

3 Lymphogenous Route

There is still considerable difference of opinion as to how bacteria reach the kidney by way of the lymphatics. At present, each of the following theories has its supporters.

(a) Those who maintain that infection from the lower urinary tract and from the genital tract, in both sexes, extends to the ureteral wall by way of the lymphatics of the respective viscera (Fig 480). In the ureter itself, the bacteria are carried to the kidney through the rich network of lymphatics in the peri-ureteral sheath or in the submucous layer of the ureter.

(b) Those who maintain that such a method of transmission in a vertical direction upwards is anatomically impossible, because the lymphatic drainage is segmental, i.e., into lymph nodes corresponding to the different levels of the ureter.

(c) Those who maintain that a lymphohematogenous route exists according to which the bacteria from the primary focus enter the regional lymphatics draining the particular structure and are carried into the general circulation by way of the thoracic duct.

Winsbury-White (Brit Jour Urol 1933, 5, 249) reported a series of experiments in which india ink and bacteria (live and dead) were injected into the cervix of guinea pigs, rabbits and rats. The animals were killed at intervals of one hour to three weeks and serial sections made. In one experiment, an unbroken

stream of pigment was found to pass by way of the lymphatics of the broad ligament to lymph glands around the common iliacs and then toward the renal hilus. No evidence of ascent was found in this experiment along the wall of the ureter but it was found that not all of the ureteral lymphatics enter the nodes which drain the ureter segmentally. In another experiment chains of inflammatory cells mostly laden with ink particles, were found lying external to the muscular coat of the ureter and invading the peri ureteral tissue. The author is of the opinion that in the majority of renal infections the bacteria follow the lymphogenous route.

FIG. 479

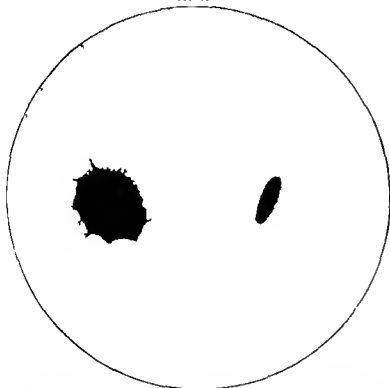


FIG. 480

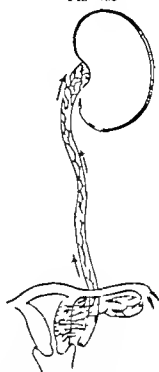


FIG. 479—Markedly gaping ureteral orifices seen in case (see FIG. 477) of reflux with severe chronic vesical and ureteral infection. Principal symptoms were frequency and pyuria.

FIG. 480—Diagram to show relation of lymphatics of the female genitalia especially of the broad ligament, to the periureteral lymphatics. The arrows indicate the direction in which infection may be transmitted to the kidney.

On the other hand MacKenzie and Wallace (*Jour Urol* 1935 35 516) reported a series of experiments on rabbits in which a colloidal solution of carbon or India ink, previously filtered, was injected into the cervix as well as into the wall of the bladder and of the ureter. They found that the dye when injected into the cervix is absorbed and passes either directly or through interposed lymph nodes into those along the common iliac vessels. The dye then passes upwards toward the thoracic duct, and, judging by one series of experiments, passes into the general circulation and thus to the kidney i.e., by a lymphohematogenous route.

We have cited these most recent studies of the subject because their results have this much in common that they show that foreign particles (carbon India ink, dead and live bacteria) are carried by the lymphatics of the cervix to the common iliac lymph nodes. From here Winsbury White finds the route is directly to the hilus of the kidney whereas the other authors believe the route to the

kidney is by way of the thoracic duct and general circulation Winsbury-White endorses the view that infection in some cases, at least, travels by way of the periureteral lymphatics as previously observed by Bauereisen, Sweet and Stewart Eisendrath and Schultz, Carson, Hess

The question evidently needs further study, but for the present, it is well to bear in mind that infection by the lymphogenous route is possible, by one or all of the three ways mentioned above

PATHOLOGY

The changes which take place in the kidney as the result of infection vary in the first 48-72 hours according to whether the bacteria are carried to the kidney by the hematogenous (descending) or by one of the so-called ascending (urogenous and lymphogenous) routes With the exception of the massive well localized type of infection (Fig 481) termed carbuncle, and the type to be described as septic infarct, the pathologic changes after 48-72 hours, according to Helmholz (Jour Urol 1934, 31, 173), are the same in both the hematogenous and ascending modes of infection

ACUTE CHANGES IN PYLONEPHRITIS

1 Acute Hematogenous Infections

The earliest changes take place in the cortex On gross examination of the surface of the kidney scattered or grouped pin-head sized or larger areas are visible which appear either as minute hemorrhages (Plate XI) or as nodules slightly raised above the level of the adjacent parenchyma, with a yellowish center and intensely red periphery

ON HISTOLOGIC EXAMINATION, these hemorrhagic or purulent foci are seen to correspond to glomeruli, in which hemorrhages or abscess formation have taken place On staining for bacteria, the blood vessels of the glomeruli are seen in many places to be filled with bacteria From the glomeruli, the infection soon extends into the medulla, so that on section of the kidney (Plate XI) in these acutely infected kidneys, one sees many minute foci of suppuration and streak-like yellowish areas radiating from the papillae to the cortex which represent areas of suppurations involving the tubules and peritubular structures

AS THE INFECTION EXTENDS from the medulla into the pelvis, the epithelial lining of the latter presents either minute or larger hemorrhagic areas (Plate XI) or is diffusely red and edematous

2 Acute Ascending (Urogenous and Lymphogenous) Infections

The earliest changes are found in the pelvis instead of the cortex, i.e., in the reverse order to the changes just described Here stasis is the most important factor favoring the extension of infection from the pelvis into the medulla and then into the cortex According to Illyes (Brit Jour Urol 1937, 9, 101) the extension into the medulla is due either to the entrance of bacteria into the straight tubules and lymph spaces or the infection extends to the subpelvic venous network and by intrinsic venous thrombosis to all parts of the kidney as well as to the main renal veins We will refer later under clinical pictures to

the fact that a suppurative thrombophlebitis of the main renal veins may be the result of either a descending or an ascending infection

RENAL CHANGES The examination of a kidney, 48-72 hours after being infected by the ascending route fails to reveal any differences in the gross (surface and sectional views) and histologic pictures from those found in descending infections

The most common causes of stasis favoring both acute and chronic renal infection are the same as those enumerated under hydronephrosis (Chapter 36) as being responsible for that condition so it will be unnecessary to repeat them here

It is necessary at this point to digress for a moment to speak of terminology as employed in renal infections As will be seen from the above description



FIG 481.—Operative specimen showing surface of kidney and sectional view in a case of carbuncle of the kidney. Note how sharply circumscribed the area of infection is in both views (Cook County Hospital case)

of the changes in acute renal infections the changes are never limited to the pelvis so that the term pyelitis is a misnomer and should be discarded in favor of pyelonephritis. The latter corresponds more accurately with our present knowledge of renal infections indicating an involvement of both the pelvis and parenchyma

3 Carbuncle of the Kidney

This is a form of acute renal infection in which a circumscribed multilocular abscess (Fig 481) is formed in the parenchyma. Graves and Parkins (*Jour Urol* 1936 35 1) collected 66 cases and added a personal case. Since publication of this paper 15 others have been reported. Analysis of the 67 cases reported by Graves and Parkins revealed a primary skin infection (furuncle carbuncle etc.) of taphylococcic origin in 42. There were 41 males and 25 females and the ages varied from three weeks to 56 years. The time elapsing between the original superficial infection and the onset of the kidney symptoms varied from a few days to many months the average being 53 days. As a rule the condition is unilateral but a bilateral case has been reported by Patch and Reid (*Brit Jour Urol* 1933 4 1934)

Not uncommonly, a minute perinephritic abscess is found over the infected renal area

The diagnosis and treatment will be discussed later

4 Septic Infarct

In this rare form of acute renal infection, one or more arterioles are blocked by an infected embolus. The result is a more or less wedged-shaped area of infarction, which soon breaks down and forms an abscess

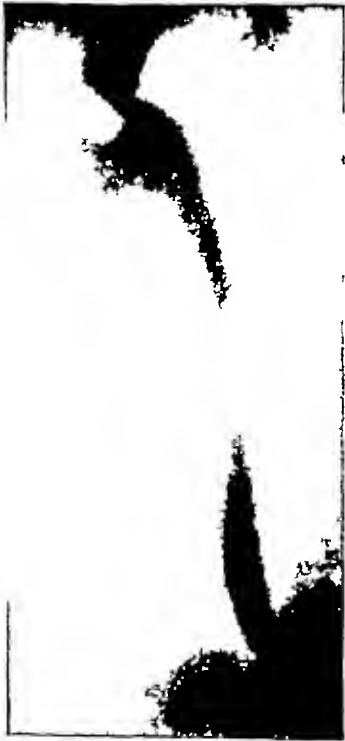


FIG 482—Urogram from case of chronic pyelonephritis in which hematuria was the outstanding feature. Note moderately advanced dilatation of the ureter and pelvis, especially observe the clubbing of the calices and widening of their necks

CHRONIC PYELONEPHRITIS

The effects of infection of long duration present one of the following pathologic pictures

- 1 Ordinary chronic, i.e., non-atrophic form
- 2 Atrophic pyelonephritis
- 3 Infected hydronephrosis
- 4 Pyonephrosis

We will consider these in the above order

1 Ordinary Chronic Pyelonephritis, i.e., Non atrophic

CHANGES IN THE RENAL PELVIS AND ITS CALICES
The gross changes are the result of infection of long standing combined with stasis. The latter is not always due to a mechanical obstruction, but can equally well be due to muscular atony as the result of neurogenic dysfunction (Fig 347) or the action of bacterial toxins (Fig 484), as pointed out by Braasch. A glance at the kidneys obtained at necropsy of a case of bladder-neck obstruction (Fig 248) shows the gross changes commonly observed in patients with chronic pyelonephritis.

The renal pelvis and its calices show a variable degree of dilatation with thickening of their walls. In many cases, there are such dense adhesions of the pelvis to the peripelvic fat and vessels, as to render exposure during a pyelolithotomy very difficult. The

mucosa of the pelvis may be of normal color, it may be red and oedematous or covered with a fibrino-purulent exudate. In a certain proportion of cases, one or more of the following associated changes may be found on the surface of the epithelial lining of the pelvis and calices

(a) **PYELITIS GRANULARIS** A number of millet-seed nodules are seen scattered over the mucosa. They are a result of chronic inflammation and show on histological examination either circumscribed areas of round-cell infiltration or true lymph follicles. Their chief clinical interest is that they can give rise to symptomless hematuria which may be so severe as to simulate that due to a neoplasm. A urogram of such a case is shown in Fig 482. Ottow and Pahl (Zent Gyn 1934, p 2256) and Baccarini (Clin Chir 1935, 11, 86) have recently reported cases of very severe hematuria due to pyelitis granularis.

(b) **PYELITIS CYSTICA** The generally accepted explanation of the origin of this condition is that of Brütt (*Zeit. Urol Chir* 1923, 14, 157) The clear translucent minute cysts found scattered over the surface of the mucosa not only of the renal pelvis but also of the ureter (Fig 371) and bladder in chronic infections are due to metaplasia of the epithelial cells of the respective mucosae resulting in the formation of glandular acini or cysts In some cases the cysts may rupture and give rise to hematuria Their chief clinical interest however is that bacteria lodged in the glandular acini are very difficult to dislodge so that infection in such cases is very resistant to treatment The urographic findings in ureteritis cystica have been described (see page 371) In the case of pyelitis

FIG. 483



FIG. 484



FIG. 483.—Kidney removed on account of infection of long standing. Note the retracted area at middle (atrophy of pyelonephritis), the greatly thickened wall of the dilated renal pelvis and ureter as well as the two calculi in dilated calices.

FIG. 484.—Ureteropyelogram from case of chronic pyelonephritis. Note markedly dilated ureter and distortion of renal pelvis, as result of atrophic changes with areas of retraction as in Figure 483.

cystica, there may be similar minute filling defects resembling those due to small calculi

(c) **LEUKOPLAKIA** This condition is due to a metaplasia of the epithelial lining not only of the renal pelvis but of the ureter bladder and urethra with cornification It presents as irregular whitish to silver gray plaques which stand out prominently against the surrounding usually somewhat reddened mucosa

In three of the thirteen personally observed cases reported by Kretschmer (*Surg Gyn and Obst.* 1928 47 145) no other pathologic condition was found. In the majority of cases leukoplakia is found in chronic nontuberculous infections of the entire urinary tract either with or without concomitant calculus formation as well as in renal tuberculosis and neoplasms of the bladder The chief

clinical interest of leukoplakia is its relation to the development of neoplasms and the resistance to treatment when a leukoplakia has developed in cases of chronic infection

CHANGES IN THE RENAL PARENCHYMA These are either the results of pressure atrophy secondary to the pyelectasis (Fig 485) or of chronic inflammatory changes with abscess formation (Fig 483) Pus is constantly poured out into the pelvis unless the abscess cavities become temporarily occluded Areas of round cell infiltration are seen between the tubules and, at a more advanced stage, in the glomeruli on histological examination In many of the cases, discrete or grouped miliary pus foci are seen on the surface and in the cortex like those observed in acute pyelonephritis (Plate XI) In the later stages, fibrosis is the outstanding feature, so that renal function is greatly diminished

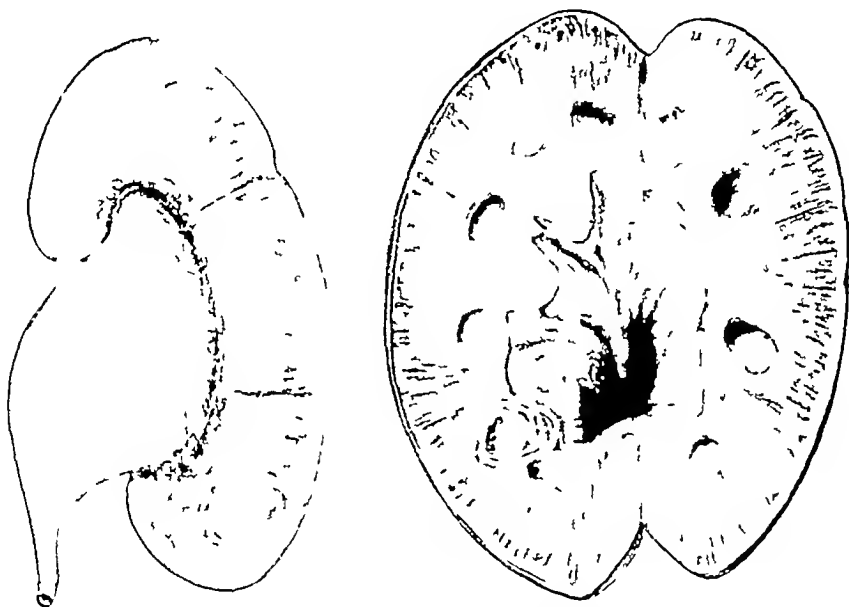


FIG 485 —Exterior and sectional view of kidney removed on account of persistent renal infection with acute exacerbations Note dilated pelvis and calices of inflammatory origin The pelvis is more involved than the calices

2 Atrophic Pyelonephritis

Braasch (Jour Urol 1927, 17, 113) was the first to call attention to this distinct type of chronic pyelonephritis It is usually unilateral but occasionally observed as a complication of chronic bilateral pyelonephritis

AN ATROPHIC PYELONEPHRITIS PROBABLY REPRESENTS THE END-RESULT OF SEPTIC (Fig 483) INFARCTS That obstruction is not a factor is evident since pyelectasis is often absent, and even when present it is never advanced enough to cause pressure atrophy of the parenchyma (Fig 485) The following is a description of typical kidneys removed for atrophic pyelonephritis (1) The kidney varies from 3-4 cm in length to approximately one-third of the normal, (2) the kidney is surrounded by dense adhesions and may be difficult to find, (3) the hilum is often invaded by large deposits of fat (Fig 483), (4) the renal pelvis is usually markedly thickened and cicatrized, and (5) on section, the cortex is irregular and shows many pale areas of cicatricial change (Fig 483) The urogram as a rule shows (Fig 484) marked deformity

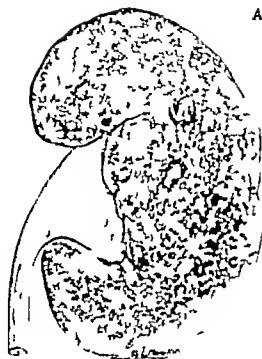
PLATE XI

A Surface view of kidney showing innumerable ecchymoses of infective origin and also a number of military and larger abscesses

B Sectional view of same kidney showing, as does A, the changes in a case of very severe pyelonephritis. Note purulent streaks radiating toward surface of kidney, also several military abscesses. Also note the multiple ecchymoses in mucosa of renal pelvis

A

B



3 Infected Hydronephrosis.

This has been discussed in the chapter on hydronephrosis. Pressure atrophy plus infection cause much more damage to the kidney parenchyma than the pressure atrophy alone. The parenchyma is reduced to a mere rim of tissue in which it is almost impossible to identify the cortex and medulla.

4 Pyonephrosis.

A sharp distinction should be made between this terminal stage of a chronic renal infection and infected hydronephrosis. In an infected hydronephrosis the parenchyma is not destroyed but simply compressed. The function may be greatly diminished or even completely abolished as the result of pressure atrophy and inflammatory changes of sclerotic type (p. 662).

DESTRUCTION OF THE PARENCHYMA. In a pyonephrosis there is actual destruction of the parenchyma by abscess formation so that the parenchyma is replaced by a number of cavities filled with pus. The pathologic changes in the renal pelvis resemble those described under chronic (non atrophic) pyelonephritis.

SCLEROSIS OF THE FATTY CAPSULE. The fatty capsule is converted into a mass of sclerotic tissue which even extends along the renal pedicle and ureter, so that separation of the kidney from this dense envelope is very difficult and at times impossible without tearing the kidney unless a special technic (see Chapter 53) is employed.

REPLACEMENT LIPOMATOSIS. In some cases of pyonephrosis there may be almost complete replacement of the parenchyma by fat—a condition termed replacement lipomatosis.

A complication which occurs not only in noncalculous and calculous pyonephrosis but also in perinephritic abscess is rupture into the peritoneal cavity so that the symptoms of a generalized peritonitis dominate the clinical picture to such an extent that the diagnosis is usually not made until operation.

Fuss (Münch Med Woch. 1934 2 1575) in addition to reporting three personal cases was able to find 31 others.

BACTERIURIA.

This term is applied to the clinical condition in which only bacteria are found in freshly voided or catheterized specimens. As a rule no cellular (pus) elements are present. The urine is turbid and does not clear on heating and the addition of a 10 per cent acetic acid solution as it would (see Chapter 8) if urates or phosphates were the cause of the turbidity of the urine. In view of the recent investigations of the question as to whether the normal kidney will permit either nontuberculous or tuberculous bacteria to pass one can say that bacteriuria is always indicative of a renal lesion. We shall take up this question in regard to the tubercle bacillus passing through a normal kidney in Chapter 41. In nontuberculous bacteriuria the underlying cause of a bacteriuria is always a chronic pyelonephritis when the bacteriuria is not a complication of an infection in the bladder or urethra. The *B. coli* group is responsible for a bacteriuria in most cases except following prostatectomy when the causative organisms are urea-splitting staphylococci or members of the salmonella group.

The Relation of Intrarenal Infection to Perinephritic Conditions.

Extension of infection by continuity or by way of the lymphatics (Fig. 495D)

from cortical foci to the fatty capsule is a frequent sequel of both acute and chronic pyelonephritis. It will be discussed in the following chapter.

CLINICAL PICTURES AND DIAGNOSIS

For clinical purposes, the following grouping of cases will be found useful:

- 1 Acute cases without and with localizing signs
- 2 Chronic cases without and with localizing signs

We will consider the clinical pictures and diagnosis, in the above order.

1 ACUTE CASES WITHOUT AND WITH LOCALIZING SIGNS

1 Acute Cases without Localizing Signs

Here the symptoms of a generalized infection completely mask any local symptoms or objective findings referable to the urinary tract. The onset is sudden, either with high temperature alone or a chill precedes the rise of temperature. Following this onset, profuse perspiration, stupor, nausea, vomiting, high pulse rate, muscular and joint pains complete the picture of an acute bacteriemia. These symptoms in the more severe fulminant type may continue in the form of recurrent cycles of chill, fever and profuse perspiration at irregular intervals and be accompanied by evidence of pericardial or endocardial involvement, suppurative arthritis, etc.

INFANCY, PREGNANCY AND PARTURITION In infants and young children as well as during pregnancy and parturition, recurrent febrile attacks without localizing symptoms should always arouse the suspicion of an acute pyelonephritis being the source. If some form of mechanical obstruction is responsible, there may be temporary recession of symptoms when, for example, a calculus changes its position (Fig 374) or some other form of obstruction allows infected urine, which has accumulated above the obstruction, to escape.

DIAGNOSIS The first step is to exclude acute infectious diseases, such as influenza, pneumonia, typhoid, cholangitis and acute infections of the genital tract in both sexes, also one must exclude the possibility of the acute symptoms being a sequel of instrumentation. If there is a history of similar attacks or of the passage of calculi, this will aid in concentrating the search for a cause, on the urinary tract. Blood cultures should be made as soon as possible in order to identify the causative organism. If the blood for culture is taken immediately after a chill, there will be a larger percentage of positive results.

RADIOGRAPHY AND UROGRAPHY In the effort to localize the source of the bacteriemia, there can be no objection to radiography of the chest and urinary tract, followed by excretory (intravenous) urography. The latter method and plain films may yield much valuable information as to the presence of an obstructing calculus (Fig 463) or of a perinephritic infection.

CATHETERS The introduction of ureteral catheters in these acute septic cases without localizing signs should be a routine procedure in order to exclude ureteral obstruction by a nonopaque calculus. Search should always be made for some recent or existing focus as the atrium of the infection, such as acute infection of the tonsils, pharynx, upper respiratory tract or skin suppuration (furuncle, carbuncle, etc.)

EXAMINATION OF THE URINE in the early hours will be of little service in acute cases of hematogenous origin, because no pus will be found until the infection has extended from the cortex to the medulla. In the urogenous and lymphogenous types pyuria is the rule, but its importance depends upon the results of a later complete urological examination.

It is inadvisable to do more than is absolutely necessary during the acute stage.

2. Acute Cases with Localizing Signs.

LOCALIZING SIGNS The mode of onset and symptoms of a generalized bacteremia are the same as in the cases without localizing signs but attention is directed to the urinary tract by certain localizing signs such as (a) severe pain referred to the upper abdominal quadrant in which the kidney is located or to the corresponding illocostal space (Fig. 379) (b) muscular rigidity over one or both of these areas, and (c) tenderness on pressure over the kidney. If such an examination is not temporarily prevented by reflex contraction of the abdominal muscles.

In some cases the onset is less stormy the fever and general symptoms appearing gradually after an initial chill or pain over the kidney. In others the symptoms recede as rapidly as they appeared because the intrarenal tension in cases of urogenous origin is temporarily relieved by escape of infected urine beyond the point of obstruction.

IN RENAL CARBUNCLE the mode of onset and the clinical picture resemble those just described. In 46 of the 67 cases analyzed by Graves and Parkins (*loc. cit.*) the actual onset was marked by pain in the corresponding kidney region. The whole clinical picture in most of the cases of renal carbuncle closely simulated that of a blood stream infection owing to the lack of symptoms referable to the urinary tract. In nearly every case however there was tenderness over the kidney often accompanied by muscular rigidity and the presence of an actual mass. Pus was found in the urine in 35 cases and blood on microscopic examination in 19 cases. The urine was normal in 16 cases.

DIAGNOSIS of acute pyelonephritis when localizing signs are present is much less difficult than when they are absent. The clinical history is of great value (a) if there have been similar attacks (b) if calculi have been passed (c) if the attack follows instrumentation or (d) an obstruction e.g. prostatic adenoma, urethral stricture, anomalies, etc. have been found at previous examinations. The most reliable symptom is localized pain as described above especially if muscular rigidity and tenderness on pressure accompany the pain.

EXAMINATION Whether the infection is of descending (hematogenous) or of ascending origin can only be determined by a systematic examination which should include

- (a) Search for a focus of infection in the throat, respiratory tract and skin.
- (b) Examination of the genitalia in both sexes and of the prostate and seminal vesicles (per rectum).
- (c) Examination of the urine.
- (d) Plain radiography and excretory urography.
- (e) Blood cultures to determine type of organism.

(f) Ureteral catheterization and use of indigocarmin (Chapter 8) as a functional test of opposite kidney

(g) Blood urea estimation

(h) Ascending urography

We wish especially to discuss the use of some of the above-mentioned urologic methods of diagnosis in these acute cases

PLAIN RADIOGRAPHY AND EXCRETORY UROGRAPHY should be routinely employed. The former will yield information as to the presence of an occluding calculus in the ureter or outlet of the renal pelvis. It may also reveal absence of the shadow of the psoas muscle, a sign of still undetermined value in perinephritic suppuration. Excretory urography is of great value (a) in ascertaining whether the ureter is blocked by a calculus or other form of mechanical obstruction, (b) if the secretory activity of the acutely infected kidney is temporarily inhibited and (c) whether another kidney is present and, if so, if the corresponding urogram is a normal one.

URETERAL CATHETERIZATION will reveal whether an obstruction exists which the preceding two methods did not reveal. This is especially true if the plain film fails to reveal a shadow when a nonopaque calculus is present, as was found in several of our cases, and the ureteral catheter encounters an impassable obstruction.

Renal Function The intravenous injection of indigocarmin is always employed by us as a test of renal function when we wish to avoid catheterization of the opposite side in cases of acute infections. The appearance time and rapidity of concentration (Plate XII) of the blue dye, yields valuable information as to the functional capacity of the non-involved kidney, in case removal of the infected kidney becomes imperative. Retrograde (ascending) urography has enabled a diagnosis to be made of the presence of a renal carbuncle in over 20 cases, hence there can be no objection to its use as a diagnostic method if care is taken never to use much pressure and to employ non-irritating solutions (see Chapter 7).

CHRONIC CASES WITHOUT AND WITH LOCALIZING SIGNS

Diagnosis

1 **THOSE WITHOUT LOCALIZING SYMPTOMS** Here the diagnosis of a chronic cystitis, or of a urethritis (see under clinical pictures) is often made because of the predominance of symptoms such as frequency, pain on urination, etc. It is only by keeping in mind the fact that a primary cystitis is rare that suspicion will be directed to the upper urinary tract. Under this heading belong also cases of persistent or recurrent symptomless pyuria and hematuria. Many of these are of renal origin, but the solution of the question as to whether they are the result of a chronic pyelonephritis alone, or one complicating the presence of a calculus, must be left to a urologic study. In other words, the topical diagnosis of the hematuria or pyuria must be based on a thorough urologic study. In regard to hematuria, a word in passing. It has been found that a chronic renal infection is a common cause of hematuria. Often the pelvic changes, especially a pyelitis granulosa, are the underlying factors (See Pathology).

2 **THOSE WITH LOCALIZING SYMPTOMS** Here there is often a history of recurrent attacks of acute pyelonephritis, ending spontaneously or after treatment. In others, there is a history of passage of calculi or of operations for renal

or ureteral calculi or of symptoms pointing to either or both of these localizations of calculi. The diagnosis is based on the various steps of the urologic study (Chapter 11) which we will not repeat here. There are, however, certain findings more or less typical of chronic renal infection which it is necessary to give at this time it being understood that a complete clinical history has already been taken and evaluated. The examination should follow if possible a certain routine so that when it has been completed all of the positive findings can be correlated. Our customary procedure is as follows:

SEARCH FOR FOCI OF INFECTION OUTSIDE OF THE URINARY TRACT This will include

- (a) EXAMINATION OF THE TEETH, NASOPHARYNX (ESPECIALLY THE TONSILS)
- (b) EXAMINATION OF THE EXTERNAL GENITALIA IN BOTH SEXES OF THE INTERNAL GENITALIA IN THE FEMALE AND OF THE PROSTATE AND SEMINAL VESICLES (Chapters 18 and 19)
- (c) EXAMINATION OF THE URETHRA IN BOTH MALES AND FEMALES FOR PRESENCE OF STRICTURE (Chapters 13 and 45)

ESTIMATE RESIDUAL URINE In the adult male by measuring the amount remaining after spontaneous evacuation of the bladder by catheterizing the patient. In the adult female one is unable to secure a specimen which will be of much value unless the patient is catheterized. However, if one wishes to estimate the amount of residual urine in females it is necessary to allow the urine to be voided spontaneously and then estimate the amount not so voided, i.e. the residual by catheterization. When a patient voids urine which is only slightly turbid or even clear and the residual is found to be very turbid (Chapter 8) one should always be suspicious of a communication between some perivesical focus of suppuration or of the presence of a vesical diverticulum (Figs. 311 and 312). In infants it is often necessary to attach a special receptacle in order to obtain a specimen.

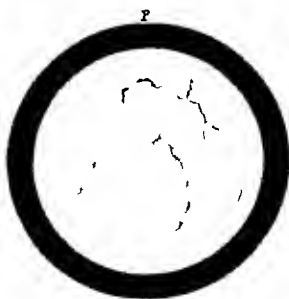
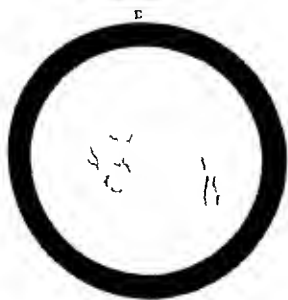
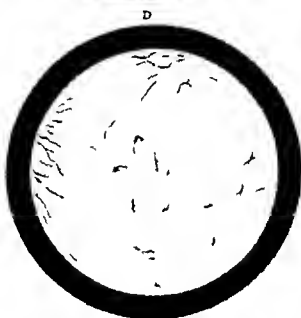
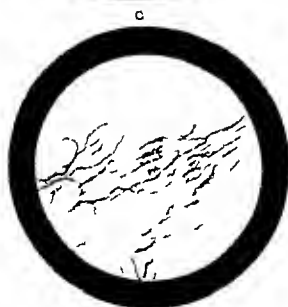
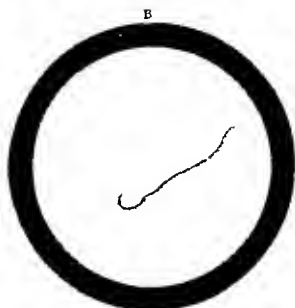
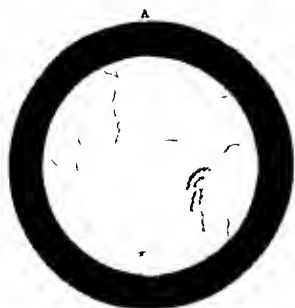
EXAMINATION OF THE URINE The bladder specimen whether spontaneously voided or obtained by catheter is only of relative value because it represents the output of both kidneys. In order to determine the type of renal infection and the degree of pyuria or hematuria, etc., specimens obtained by ureteral catheterization are indispensable. Such separate urines as they are termed should be stained by the Gram method, culture media inoculated and the specimens examined both chemically and microscopically as described in Chapter 8. We always keep some of the separate urines until the next step of making the diagnosis of a pyelonephritis is completed. If cystoscopy gives the least suspicion of renal tuberculosis being the cause of the chronic infection smears are made and guinea pigs¹ inoculated. Perhaps in the near future cultural methods for the early (three to four weeks) recognition as recommended by E. Loewenstein (see Chapter 41) may be more generally employed for the detection of tubercle bacilli.

CYSTOSCOPY In many cases of chronic pyelonephritis there is an absence of vesical findings. This was true of 40 per cent of 80 cases studied by Geisinger and in 33 per cent of 116 cases studied by Culver. When bladder changes are present they vary greatly. One may find all gradations from simple hyperemia up to marked edema and redness of the trigone. The appearance of the remainder

¹In one clinic (Univ. of Michigan) the separate urines are routinely inoculated into guinea pigs. In this way it has been possible to make a diagnosis of renal tuberculosis at times when only a nontuberculous infection was suspected.

PLATE XII

- A Bloody efflux from left ureteral orifice (Joseph)
- B Thick pus being expelled from ureteral orifice (Joseph)
- C Indigo-carmin being expelled from the lower (more lateral) of the two ureteral orifices of a case of double kidney (Joseph)
- D Bullous edema around ureteral orifice on tuberculous kidney side (Joseph)
- E Miliary tubercles surrounding a gaping "golf-hole" ureteral orifice (Joseph)
- F Edematous, gaping ureteral orifice in chronic pyelitis (Joseph)



MANDELIC ACID It was at this stage, that Rosenheim (Lancet 1935, 1, 1034) found that mandelic acid, which we shall discuss in the next paragraph, could be employed as a substitute for betaoxybutyric acid. It had the great advantage of escaping metabolism or conjugation in the animal organism and was excreted in the urine in a concentration sufficient for bactericidal action, provided the pH of the urine was simultaneously lowered.

C URINARY ANTISEPTICS FOR ORAL ADMINISTRATION Those employed until recently (1935) which have stood the crucial test of clinical application are methenamine (urotropin), acroflavine and pyridium. The use of the salts of mandelic acid and of sulfanilamide is still too recent to be able to give a decision on their being substitutes for the above mentioned antiseptics in the treatment of acute and chronic pyelonephritis.

METHENAMINE is the term now commonly used instead of hexamethylenamine or its trade name, urotropin. It still occupies a high rank in the list of urinary antiseptics for oral administration. Its action depends upon the liberation of formaldehyde in the urine. The average dose is up to 30 grains daily. Larger doses are apt to be followed by hematuria and burning on urination, even tenesmus, due to congestion at the vesical neck. It is advisable to give the drug for 3-4 days and then discontinue it for 24-48 hours to avoid disagreeable bladder effects in many individuals.

Helmholz (Mayo Clinic Bulletin 1932, 7, 374) called attention to the fact that a low pH of the urine is necessary for effective bactericidal action of methenamine. For this reason, it is the custom to give the drug and a urinary acidifier like ammonium chloride or nitrate simultaneously. Methenamine and the acidifier can be combined in a solution or preferably in tablet form, the acidifier in special coated tablets.

AMMONIUM CHLORIDE Oppenheimer (Jour Urol 1935, 33, 22) reported four cases in which the use of ammonium chloride in amounts not excessive for a normal individual led to acidosis. While the apathy and stupor suggested renal insufficiency, the clinical impression of acidosis was deduced from a knowledge of the medication given and was confirmed by the chemical findings. Large doses of ammonium chloride such as 15 or 20 Gm produce acidosis with a reduction of 0.2 in the pH of the blood. The usual dose (8 Gm daily) is not followed by serious acidosis if the renal function is good, but may produce severe symptoms if slight or moderate impairment of function exists.

ACROFLAVINE, PYRIDIUM, AZO DYES Acroflavine, although an excellent antiseptic for local use in the treatment of urethral and bladder infections, has never given very satisfactory results when given by mouth or intravenously. Pyridium and the azo-dyes have been extensively employed during the past few years, but opinion as to their bactericidal action is still far from unanimous. Walther (Jour Amer Med Assn 1937, 109, 999) believes that these dyes have been found to be a most valuable adjunct in the majority of cases in which they were used but that sometimes they failed completely. Gillespie (Mayo Clinic Bull 1932, 7, 372) found no bactericidal properties in any of the concentrations of pyridium. There was no tendency to kill or even inhibit *Escherichia coli* in urine having a concentration of pyridium even as low as 1 to 1600 or 1 to 1800. The recommended dosage of 0.2 Gms of pyridium, even with restricted water intake, would not attain, ac-

according to Gillespie a concentration sufficient to inhibit even *Staphylococcus aureus*

Walther (loc cit) in reply to a questionnaire sent to a number of urologists, found that according to 33 per cent of the answers pyridium and the rest of the azo-dyes seemed to be of no material benefit 46 per cent stated that they were definitely of value 21 per cent had never tried them

MANDELIC ACID AND ITS SALTS Rosenheim in 1933 (loc cit.) found that this acid had the advantage over betaoxybutyric acid of not being metabolized in the human organism and that the complicated ketogenic diet could be dispensed with Mandelic acid is an aromatic, hydroxyacid which chemically is known as hydroxy phenyl acetic acid Helmholtz (Jour Amer Med Assn 1937 109 1039) found that betaoxybutyric acid and mandelic acid act bactericidally in about the same concentration and in the same range of pH Both require organic acid concentrations of from 0.5 to 1.0 and a pH of the urine between 5.0 and 5.5 anything that prevents achieving these conditions vitiates the treatment This is especially true of reduced renal function hence the condition of the kidneys must be taken into consideration in the evaluation of the results In infections with urea splitting organisms such as the proteus group the alkalinity of the urine is usually such that in spite of the use of acidifiers the urinary pH rarely approaches 5.5 Helmholtz and Osterberg (Bull Mayo Clinic 1937 12 377) have shown that mandelic acid acts bactericidally not only on all of the gram negative bacilli found in primary infection but also on *Staphylococcus aureus* and *Streptococcus faecalis* Mandelic acid is now generally given in the form of the ammonium salt. If the urine does not reach the necessary pH of 5.5 ammonium nitrate can be given in addition

The usual adult dose is 3 Gm four times daily taken after each meal and at bedtime The twenty hour quantity of urine should be kept at about 1000 cc For children the dosage is proportionately smaller The proper acidity of the urine can be determined daily by the patient with Squibb's nitrozone paper or indicators furnished by the La Motte Chemical Company of Baltimore

If the necessary acidity is not attained with ammonium mandelate alone ammonium chloride or nitrate in doses of from 0.5 to 2 Gm four times a day is given

Cook (Bull Mayo Clinic 1937 page 215) advised giving ammonium mandelate for 6-12 days If the urine is not free of bacilli at the end of this period it is better to discontinue the drug for 10-14 days and then institute a second course of treatment. More than 80 per cent of the uncomplicated cases of bacillary infection respond to this form of therapy (Cook) If cicatricial changes in the renal pelvis or calices residual urine in the bladder or kidney chronic prostatitis calculus neoplasm or foreign bodies are present the chances of cure are definitely reduced and in many cases cure is impossible unless the complication is removed.

Mandelic acid therapy and urinary acidification are contraindicated when there is evidence of renal insufficiency

SULFANILAMIDE (PRONTYLIN) This most recent addition to the list of bactericidal drugs has been employed clinically not only for urinary infection but for all types of infections since 1935 Helmholtz (Jour Amer Med Assn 1937 (Sept 25) 109 1039) found that with concentrations of sulfanilamide easily obtainable by oral administration of the drug the urine is bactericidal for

Staphylococcus aureus, *Escherichia coli*, *Aerobacter aerogenes* and organisms of the proteus and pseudomonas groups. The bactericidal action of sulfanilamide in alkaline urine gives hope for successful treatment of infections due to the proteus group of organisms which are resistant to mandelic acid as well as to other forms of therapy dependent on an acid urine.

DIFFERENTIAL USE The ketogenic diet and mandelic acid can only be given in subacute and chronic pyelonephritis, whereas sulfanilamide can be administered in the acute febrile stage. Acting best in an alkaline medium, sulfanilamide can be given along with sodium bicarbonate and sodium citrate which, together with the forcing of fluids, has been adopted at The Mayo Clinic as the treatment of the acute stage.

Cook and Buchtel (Bull. Mayo Clinic 1937, 12, 381) recommend giving an initial dose of 60 or 80 grains (4 or 5.3 Gm) daily for one or two days and then reduced to a maintenance dose which is usually 40 grains (2.6 Gm) daily for a maximal period of ten days.

The greatest objection to the use of sulfanilamide and of prontosil, a proprietary product related to it, is that they cause toxic symptoms and skin eruptions to a variable degree in many patients.

2 Intravenous Administration of Urinary Antiseptics

The only two urinary antiseptics which are given at times by this route are Methenamine and Neoarsphenamine. Solutions of the former may be obtained in ampoules containing 30 grains. Their use once in 24 hours is indicated in patients who are too ill to be given the drug by mouth. Neoarsphenamine appears to be very efficacious in the treatment of chronic pyelonephritis due to staphylococci. Wildbolz is very enthusiastic in advocating the drug in the treatment of resistant infections of this type. Campbell has found neoarsphenamine very efficacious in the staphylococcus bacteriuria of children. The drug is given as in the treatment of syphilis. If the urine is not sterilized in six doses, the injections should be discontinued.

3 Vaccines and Bacteriophage

Interest in the use of vaccines in urinary infections has been reawakened by the work of Cumming and other American urologists during the past few years. Cummings (Jour. Urol. 1936, 35, 540 and 1937, 37, 226) has subjected patients to complement fixation and cultural studies. Vaccines have been made which contained suspensions of killed organisms of the same strain to which the patient seemed hypersensitive. Vaccines so produced are extremely powerful, exhibit a high degree of specificity, and occasionally produce violent systemic reactions, even when administered in minute doses.

Another advocate of vaccine therapy is M. Solis-Cohen (Urol. and Cut. Rev. 1936, 40, 231) who prepares pathogen-selective vaccines prepared from all the organisms found in the different areas cultured, the organisms that grew in the patients' blood constituting 90 per cent of the vaccine and the other organisms, ten per cent, the latter being included as possibly possessing antigen value.

It is too soon to attempt to pass any judgment on whether vaccines should have a place in the armamentarium of the urologist in the near future or not. The bacteriophage question is in the same status as is the recently reawakened interest

in vaccines. Sufficient data have not accumulated to draw any conclusions. Wehrlein and Verb (Am J Surg 1935 29 48) report that they have cured 7 out of 10 cases of acute pyelonephritis in one treatment, but only 5 of 24 sub-acute and chronic cases were cured. Thirteen were improved but in 6 the treatment was a failure. In 97 patients with colon bacillus infection treated with bacteriophage by MacNeal, Frisbee and Applebaum (Arch Surg 1934 29 622) 23 were cured, 27 showed symptomatic improvement, in 24 there was no satisfactory follow up and in 23 there was complete failure.

Use of Inlying Ureteral Catheter and Pelvic Lavage

THE FORMER METHOD is of great aid in chronic pyelonephritis cases where drainage has been inadequate and the patient is in poor condition for any operative procedure. We prefer to use relatively small size (5 F) opaque ureteral catheters because the coating is more resistant to the action of the urinary salts than are plain catheters. No attempt is made to irrigate the renal pelvis, there being ample drainage alongside the catheter. There is no time limit as to how long the catheter can be left in situ. If the urine becomes clear the catheter can be withdrawn; otherwise it can be safely left in situ for 2-3 weeks. If there is a tendency for the ureteral catheter to be expelled when the patient voids, we also drain the bladder by an inlying urethral catheter (Fig. 101). In the female a Malecot (Fig. 69) catheter is preferable for bladder drainage in order to prevent expulsion.

LAVAGE OF THE RENAL PELVIS still remains a great aid in the treatment of chronic pyelonephritis. Small caliber ureteral catheters are preferable, the excess of fluid being able to flow back into the bladder and thus to avoid overdistension of the pelvis. Of all the drugs for lavage of the renal pelvis, nitrate of silver or one of the colloidal silver preparations have given us the best results. If nitrate of silver is used, it is advisable to begin with a 1/1000 solution in distilled water and then increase the strength up to a 1 per cent solution. The contents of the renal pelvis are first aspirated with a syringe (Fig. 131) and then 10 cc. of the solution is injected with only slight pressure. This can be repeated once or twice at the same sitting. Pelvic lavage ought never to be done more than once a week. The lavages can be discontinued as soon as the urine is clear and the cultures negative.

Elimination of Foci.

This includes a search for possible primary sources in the teeth, tonsils, nasal sinuses, upper respiratory tract, cervix, uteri, prostate and seminal vesicles. In a certain number of cases the renal infection persists even after every effort has been made to eliminate primary foci.

The Removal or Treatment of Causes of Stasis.

The lesions at or distal to the ureteropelvic junction may be placed in two groups: the mechanical and those due to neurogenic dysfunction.

LESIONS CAUSING MECHANICAL OBSTRUCTION

(a) URETHRAL such as congenital lesions (phimosis, strictures and valves) and those of acquired origin (inflammatory and traumatic stricture, calculi).

(b) **VRSCAL**, such as the various types of bladder neck obstructions, neoplasms, calculi and diverticula

(c) **URITURAL**, such as congenital lesions (strictures, anomalous blood vessels, diverticula, ureterocele) and those of acquired origin (any form of obstruction having its origin in the ureteral wall or adjacent structures)

(d) **RENAL**, such as obstruction by various types of lesions (nephrolithiasis (Fig 488), neoplasms, acquired and congenital strictures) at the ureteropelvic junction

Indications for Operation in Chronic Pyelonephritis

The underlying principle of the treatment of chronic renal infections is to make every possible effort to save the kidney. Much can be accomplished by the various methods of treatment just discussed plus provision for temporary or permanent drainage by means of nephrostomy, uretero- or pelvolithotomy, plastics for hydronephrosis and for anomalous vessels, etc.



FIG 491—Urograms from case of persistent advanced bilateral pyelonephritis with calculus formation. Note dilatation of ureters, pelvises, and especially, of calices.

In movable kidney, nephropexy is indicated if proof can be furnished (Chap 35) that the stasis is the result of the abnormal mobility and the resultant kinking of the ureter.

Nephrostomy is indicated in cases of apparently functionless kidneys. One or both kidneys can be drained in this way for an indefinite period and the nephrostomy can be supplemented by the giving of bactericidal preparations (see treatment) Sisk, Wear and Cummings (*Amer Jour Surg* 1934, 25, 251) and Schulhof (*Surg Gynec and Obst* 1937, 65, 188).

have recently called attention to the definite improvement in renal function in chronic pyelonephritis following nephrostomy.

Nephrectomy is indicated in functionless kidneys, if (a) every effort, both nonoperative and operative (nephrostomy), has been made to save the kidney, and (b) there is recurrent formation of renal calculi, in spite of attempts to prevent recurrence (see Chap 42). This means that nephrectomy is indicated (a) in pyonephrosis, especially when associated with calculus formation, (b) in infected hydronephrosis due to any type of obstruction and (c) in atrophic pyelonephritis if the kidney is functionless and conservative measures are of no avail in controlling the infection.

CHAPTER 40

PERI AND PARARENAL INFECTIONS (NON TUBERCULOUS)

MODES OF INVASION OF THE PERINEPHRIC FATTY CAPSULE
ANATOMIC CONSIDERATIONS
LOCATIONS OF PERI AND PARANEPHRITIC ABSCESS
BACTERIOLOGY AGE AND SEX

CLINICAL PICTURES
ACUTE PERINEPHRITIC ABSCESS
DIAGNOSIS
TREATMENT OF PERINEPHRITIC ABSCESS
FIBROSCLEROTIC OR FIBROLIPOMATOUS PERINEPHRITIS

The term perinephritis is loosely applied clinically to designate an infection in the fatty envelopes of the kidney. Anatomically it is necessary to distinguish the perinephric fat proper which is to be found (Fig. 493)

between the anterior (prerenal) and posterior (retrorenal) layers of the fascia of Gerota from the paranephric fat which is external to the fascia of Gerota and separates the latter (Fig. 493) from the muscles lying behind the kidney (Fig. 12). Clinically it is impossible to distinguish between a perinephritis and a paranephritis.

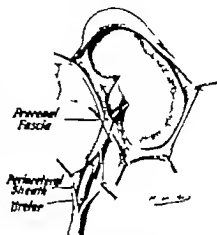


FIG. 492.—Relation of periureteral and perirenal sheaths to ureter and kidney. This shows how infection may travel in the periureteral tissues to the perinephric fat. See also Fig. 17.



FIG. 493.—Diagram to show an abscess (A) which has broken through the renal fascia and is now located in the subphrenic region. Note absence of closure of the renal fascia at lower pole of kidney.

MODES OF INVASION OF THE PERINEPHRIC FATTY CAPSULE

A. By the Hematogenous Route

The bacteria are rarely carried by way of the blood vessels directly (A and B of Fig. 495) to the perirenal fat. In the majority of acute cases the perirenal infection is secondary to coccal infection of the renal cortex (C of Fig. 495). The cortical abscess may rupture into the perinephric fat directly or the infection may extend (D of Fig. 495) by way of the free communication between the renal and perirenal lymphatics.

B. From a Pre-existing Chronic Pyelonephritis

This often gives rise either to an acute perirenal suppuration or to a chronic perinephritis (Figs. 498 and 499) of a non suppurative fibrous or fibrolipomatous type.

C From Appendiceal Focus of Infection

By extension from a focus of infection in or around the appendix, especially if the appendix is retrocecal (E of Fig 495), from the duodenum, colon or liver

D Infection of the Retro-peritoneal Tissues and Especially of the Perirenal Tissues

This may result from extension upward along the posterior peritoneum or along the peri-ureteral sheath from the prostate, seminal vesicles, parametria or bladder (see Fig 492 and F of Fig 495)

E Transcapsular Rupture of the Kidney

This, due to either a subparietal injury or a penetrating object giving rise to a hematoma, may result in secondary infection and perinephritic abscess (Chapter 33)

ANATOMIC CONSIDERATIONS

1 Role of the True or Fibrous Capsule of the Kidney

The renal capsule, i.e., the true or fibrous capsule, is a structure which contains in addition to fibrous tissue, some smooth muscle and elastic fibers. It

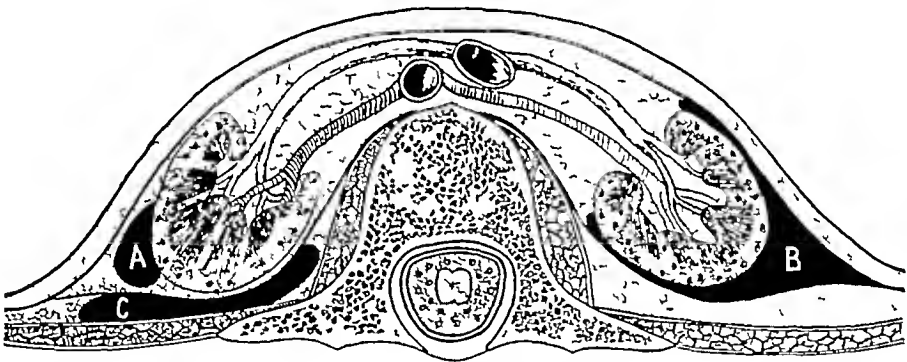


FIG 494 —Diagrams to show location of most common para- and perinephritic abscesses

A Localized abscess in the perinephric fat

B Diffuse suppuration in the perinephric fat

C Abscess in the paranephric fat between posterior layer of renal fascia and lumbar muscles

envelops the kidney somewhat loosely, but quite securely, and covers it much in the manner of a hood, being firmly attached at the hilus, where the pelvis and vessels enter. Due to this loose attachment, the fibrous capsule can be readily freed from the surface of the kidney, and thus decapsulation can be done without injury to the parenchyma. All other parenchymatous organs have a capsule which is firmly attached, and cannot be removed without injury to the underlying parenchyma. The loose attachment and the elastic fibromuscular structure of the true renal capsule, permit its perfect adaptation to changes in the size of the kidney which result from variations in intrarenal tension.

The protective role of the fibrous capsule is seen in subparietal (Chapter 33) injuries of the kidney, most of which are subcapsular. Even when the kidney itself is extensively damaged, the capsule remains intact. In cases of perinephritic abscess of extrarenal origin, extension to the kidney only occurs when an erosion of the protective fibrous capsule has taken place.

Even in diffuse perirenal sclerosis (A of Fig 499) the infection is carried to the perirenal fat by way of the lymphatics around the renal pedicle (Fig 31) no direct extension from the cortex to the perirenal fat taking place

In extensive peri renal sclerosis commonly associated with chronic calculous pyonephrosis and also in replacement lipomatosis (Fig 523) where the kidney is almost entirely replaced by fat, the barrier of the capsule still remains. A plane of cleavage can practically always be found between the true or fibrous capsule and the kidney and the kidney can usually be readily shelled out from the surrounding infiltration when this plane of cleavage (Figs 718 719 and 720) has been reached. However if the patient who has had a chronic peri renal infection has been previously operated and decapsulation was done there is no barrier to the spread of infection to the kidney from without and vice-versa from the kidney outwards to the surrounding tissue. Thus in operations on the kidney where decapsulation has been previously done particularly in chronic calculous pyonephrosis one frequently finds a solid mass of infiltrated scar tissue in the loin in which the kidney is often indistinguishable or completely destroyed. Thus decapsulation can be a decided hindrance if a secondary operation must be done.

We have found (Jour Urol. 1937 38, 421) that when fluid is injected beneath the true or fibrous capsule it is rapidly absorbed by the kidney. When an indigo-carmin solution is employed this absorption can be verified by the fact that urine obtained by ureteral catheterization is stained by the dye almost immediately after the subcapsular injection of the blue solution. There is evidently a constant interchange of tissue fluids between the kidney and the subcapsular space.

We have found at operation a condition which might be termed hydrocele of the kidney, in which there is an accumulation of fluid under the capsule. This is probably due to slow re-absorption by the surface of the kidney and may indicate some renal deficiency.

2 Role of the Renal Fascia

The perinephric fat is enclosed in an envelope formed by the pre- and retrorenal layers of the renal fascia or fascia of Gerota. These layers are united above but not below as best seen in a coronal section (Fig 493). In a horizontal section (Fig 494) these two layers of the renal fascia fuse along the outer (lateral) border of the kidney while toward the inner (mesial) border they are continued over the vessels and may or may not unite with similar layers from the opposite side of the body. As the result of the absence of fusion at the lower pole there is a direct communication not only between the fat surrounding the kidney and that of the ureter (Fig 492) but also of this perirenal and periureteral fatty tissue with the cellular tissue around the true pelvis. In addition to this perinephric fat there is another cushion or layer of adipose tissue known as the paranephric fat which lies between the retrorenal or posterior layer of the fascia of Gerota (Fig 493) and the muscles of the posterior abdominal wall (Fig 494). This paranephric layer of fat varies greatly in thickness and is in direct contact with the inferior surface of the diaphragm. The blood supply of the perinephric fat is derived from branches of the main renals, the adrenals and spermatics. The arteries as well as the veins form a network around the kidney (Fig 30).

LOCATIONS OF PERI- AND PARANEPHRITIC ABSCESS

A primary localization of infection in the peri- or in the pararenal fat is rare. In the majority of cases, a perinephritic abscess is due to an extension into the perinephritic fat of a primary focus in the kidney. The perinephritic abscess is usually quite localized and in direct contact with the renal focus. There may

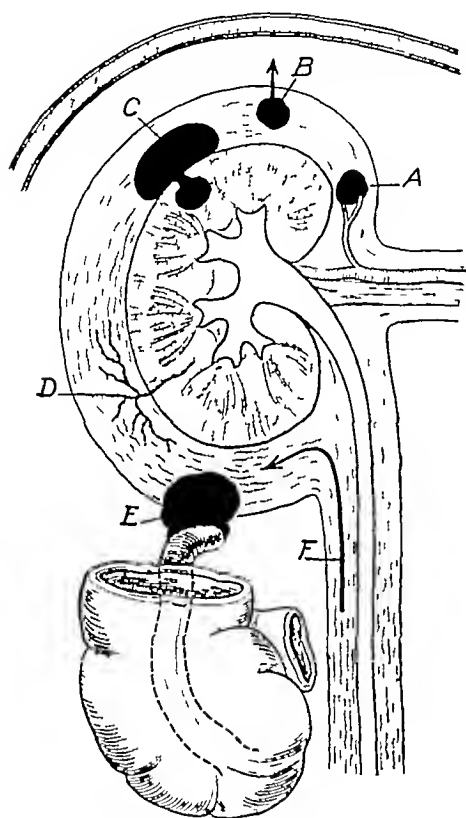


FIG 495—Diagram to show sources of perinephritic abscess

A Hematogenous form, foci of infection elsewhere in body (see text)

B Extension of perinephritic abscess to subphrenic space

C Extension of infection from cortical abscess of kidney to fat around it

D Same as C but by way of lymphatics

E Retrocecal appendiceal abscess extending to perinephritic fat

F Extension of infection from prostate, etc., along periureteral sheath

be only a single or several such perirenal abscesses, depending on how many cortical foci communicate directly (A of Fig 494 and B of Fig 495) or indirectly (D of Fig 495) with the perinephritic fat. Hence in operating, it is well to bear this in mind, by palpation of the cortex for other foci. A perinephritic abscess on the anterior aspect of the kidney is relatively uncommon. Most often, the abscess is near one of the poles or along the posterior surface (C of Fig 495) of the kidney. The early symptoms depend on the location of the abscess. Although at first localized in the perinephritic fat, the suppuration may become diffuse (B of Fig 494) and then break through the fascia of Gerota so that the paranephritic fat is involved (A of Fig 493). If this extension takes place at or near the upper pole of the kidney, a subphrenic abscess (Figs 493 and 497) may result with possible rupture into the pleural cavity or even into the bronchi. As a rule, however, suppuration in the perinephritic fat does not extend very far in an upward (cephalad) direction, being limited by the union of the prerenal (anterior) and retrorenal (posterior) layers of the fascia of Gerota (Fig 492). In a downward direction, such a limitation of the spread of infection can readily occur or vice versa, it may extend from the periureteral (Fig 492) to the perirenal fat.

The perinephritic fat lying within the fascia of Gerota is adherent indirectly in front to the posterior parietal peritoneum and indirectly behind to the quadratus lumborum and psoas (Fig 494) muscles from which it is separated by the pararenal fat. Large accumulations of pus may occur in front of the kidney without showing localizing symptoms. We have recently observed such a case in which a septic condition developed following transvesical diathermy for tumor. About two weeks after the operation, a mass was found in the left upper quadrant. Exploration through the usual kidney incision revealed an abscess containing 1500 cc of pus, which was found in front of the kidney.

BACTERIOLOGY AND SEX

In the majority of cases the perinephritic abscess is the result of the metastatic localization of bacteria of the coccal type. The primary focus is usually a furuncle, a carbuncle or some similar focus in the superficial tissues. In one of our series, the abscess followed the infection incident to the bite of a mosquito. Staphylococci are more commonly the causative organisms than any other type of pyogenic bacteria. Their localization in the cortex of the kidney is very often followed by extension as explained above to the perinephric fat. In perinephritic abscess secondary to a pyelonephritis the organisms most commonly found belong to the *B. coli* group. At times cases are encountered in which the abscess developed as the sequel of an infection of the upper respiratory tract. In one of

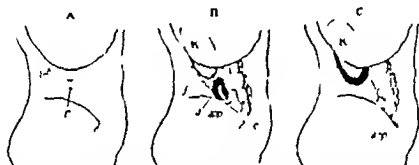


FIG. 496—A Area of rigidity and tenderness over iliocecal space in both a retrocecal appendiceal abscess and one around lower pole of kidney.

B Diagram to show proximity of a retrocecal appendiceal abscess to kidney. (A) is abscess cavity.

C Perinephritic abscess at lower pole of kidney.

our cases a child who had an infected vaccination wound gave a history of having been kicked over the right costovertebral region a few days before the vaccination. The clinical picture of a right sided perinephritic abscess presented about three weeks after the injury. The injury had no doubt favored the localization in the kidney of bacteria from the infected vaccination wound.

CLINICAL PICTURES

ACUTE PERINEPHRITIC ABSCESS

These vary greatly but in general one may speak of cases presenting a typical and those presenting an atypical clinical picture.

1 **Typical Cases.** Tenderness and rigidity over the corresponding iliocecal space (Fig. 496) persisting high temperatures and leukocytosis are the triad of symptoms which should lead to the suspicion of the presence of a perinephritic abscess especially if there is a history of some primary skin or upper respiratory tract infection or of trauma over the kidney region. Examination of the urine in most cases fails to reveal any abnormal changes. A unilateral bacteriuria has been mentioned by some authors but it is not constant enough to be of any value. There may be fixation of the lumbar region on movement and a deviation of the spine to the opposite side. When the perirenal involvement is very marked

and especially if there is an extension downwards, the thigh and leg of the involved side may be flexed. This may be of some diagnostic value.

When a trauma has preceded the abscess, the involved side is tender and some tumefaction and fever are to be noted.

Metastatic (hematogenous) infection of the perinephric fat may occur, but it is relatively rare and gives rise to the same clinical pictures as when the perinephritic abscess is secondary to a metastatic focus in the renal cortex.

2 Atypical Cases The clinical picture in this group can be best illustrated by the history of a patient seen by one of us. A young man, 20 years of age, was seen on account of a steady rise of temperature with but slight morning remissions, marked leucocytosis and a negative Widal reaction for typhoid. About three weeks before, a large furuncle on the back of the neck had been opened. There was a complete absence of any localizing symptoms except moderate rigidity over the right ilio-costal space (Fig. 496). Further examination revealed the presence of a right perinephritic abscess whose drainage was followed by recovery.

In general, we cannot urge too strongly always to keep in mind the existence of a perinephritic abscess in all cases of persistent rise of temperature especially in the absence of any localizing signs indicating such a source of the fever.

DIAGNOSIS

The objective findings are of considerable value. They include:

(a) **Plain Radiography** Obscuration of the psoas shadow of the involved side appears early and is a frequent finding. Irregularity of the renal outline at the site of the abscess can sometimes be noted early. The diaphragm is often elevated and fixed on the involved side. There is no renal mobility on fluoroscopy. However we can recall one case diagnosed as renal tumor with extreme mobility of the kidney which proved to be a perinephritic abscess.

(b) **Excretory or Retrograde Urography** The abscess may compress¹ the kidney to such an extent, as to give rise to changes which may simulate those observed in renal tumors (see Chapter XLIII) in the form of filling defect or deformities (B of Fig. 498 and Fig. 508) of the renal pelvis and its calices. As a rule, these disappear following drainage of the abscess. The ureter may be deviated, or the kidney rotated and displaced mesially, laterally, upwards or downwards.

The above objective findings taken in conjunction with the clinical history will enable the diagnosis to be made in most cases.

We were impressed in a review of a series of cases by the long interval between the appearance of symptoms and the diagnosis which is often made very late in atypical cases.

Retrocecal appendicitis (Fig. 496) may offer considerable difficulty in differentiation. Lumbago can be readily differentiated.

Acute staphylococcus cortical infection of the kidney, according to Beer, will give rise to costo-vertebral tenderness, rigidity and leukocytosis, but when no suppuration develops, the symptoms clear up within a few days. When localizing symptoms persist for a week or more, then perinephritic abscess must be considered.

¹ Menville has reported four cases in which a lateral view of a retrograde pyelogram revealed displacement anteriorly of the kidney by the perinephritic abscess.

There are many conditions which may simulate perinephritic abscess especially is this true of those abscesses following infection around a retrocecal appendix as shown in Fig. 496



FIG. 497—Radiograph of right sided subphrenic abscess. Note elevation of right dome of diaphragm and obliteration of the costophrenic sinus. (Michael Reese Hospital)



FIG. 498—Pyelograms, illustrating how perirenal conditions may cause pyelographic changes.
A. Marked distortion of calyces due to perirenal sclerosis.

B. Marked compression of calyces and renal pelvis with displacement of ureter in perinephritic abscess. (Dr. Koll's case)

Chronic suppurative perinephritis may simulate typhoid fever, tuberculosis, dysentery, and gastro-enteritis. When the abscess is sub-diaphragmatic it may present symptoms due to diaphragmatic or pleural irritation and may be mistaken for chronic bronchitis or empyema.

TREATMENT OF PERINEPHRITIC ABSCESS

Operative interference through the ordinary lumbar incision (Chapter 53) is indicated as soon as the presence of a perinephritic abscess is suspected in order to prevent extension of the infection. Beer recommends decapsulation with drainage of the abscess as the best form of treatment, for diffuse coccal infection of the kidney. We are of the opinion that if the patient is very septic and one has established the presence of a good functioning opposite kidney with the aid of excretory urography, that it is better judgment to remove such a diffusely infected kidney (see Plate XI) after opening the perinephritic abscess. In most cases, however, there is only a single or perhaps a second cortical focus of supuration which is responsible for the perinephritic abscess. If such be the case, simple incision and drainage of the cortical foci suffices, without exposure of the entire kidney and decapsulation.

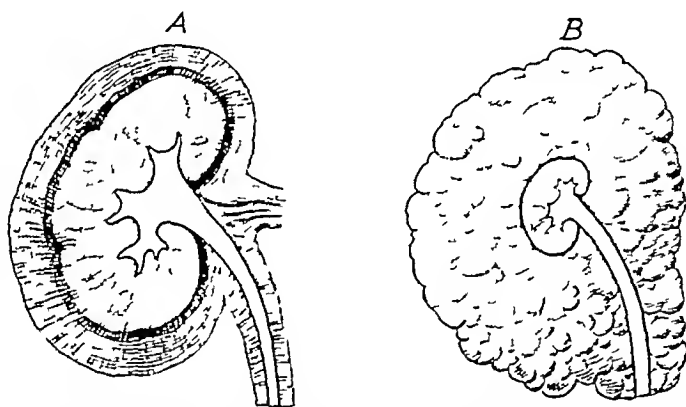


FIG. 499—A Marked perirenal thickening involving also ureter and renal vessels
B The kidney after protracted infection has become atrophic and is completely buried in a mass of fibrolipomatous tissue

In some cases where the kidney shows evidence of considerable destruction, and suppuration continues for a long time, secondary nephrectomy is necessary. This is usually a difficult procedure.

When the infection has been the result of extension upward from the parametria in the female, a simple incision in the loin is frequently insufficient. A low anterior abdominal incision with counter drainage helps considerably because this abscess cavity extends along the course of the entire posterior peritoneum. In some cases vaginal drainage may be necessary.

We have observed a number of cases clinically, demonstrating ascending infection from the adnexa and also cases of descending infection from the kidney along the peri-ureteral sheath. In one case, a right perinephritic abscess developed as a puerperal complication. Following drainage, a left sided perinephritic abscess presented which was also drained. In a second patient, the perinephritic suppuration followed a chronic prostatovesiculitis. In a third case, the perinephritic abscess followed erosion by a calculus of the bed from which the prostate had been removed one year before.

When a carbuncle of the kidney is present it can usually be excised or curetted, and the rest of the kidney saved. Even though the involved area is

extensive this can be done relatively safely for it is a bloodless procedure because there is often an accompanying infarction of the vessels supplying the involved area.

FIBROSCLEROTIC OR FIBROLIPOMATOUS PERINEPHRITIS

As the result of chronic inflammatory changes due to infection the perirenal fat is replaced by a fibrosclerotic or fibrolipomatous tissue which forms an envelope varying in thickness (Fig 499) from a fraction of an inch to one or more inches. This sclerotic transformation of the perinephric fat not only surrounds the kidney proper but also its pelvis (peripyelitis sclerotica), the vessels of the pedicle and even the ureter.

Fibrosclerotic or fibrolipomatous perinephritis also sometimes termed "perirenal sclerosis" is nearly always secondary to a pre-existing chronic renal infection but it may occasionally follow acute localized cortical suppurative foci. Such perirenal changes have also been observed after a severe injury of the kidney. Of all of the sources of chronic renal infection a fibrosclerotic or fibrolipomatous perinephritis most frequently complicates a calculous pyonephrosis or a tuberculous pyonephrosis (see Fig 718). At times a carbuncle of the kidney (Fig 481) may be complicated by a considerable degree of fibrous perinephritis.

Diagnosis. Clinically, one is seldom able to recognize a fibrosclerotic or fibrolipomatous perinephritis before operation because of the predominance of the symptoms due to the underlying chronic infection in the kidney. A persistent dull pain in the kidney region following injury should lead to the suspicion that such perinephritic changes are responsible. One must think of such a condition in cases of perinephritic abscess following operation if excretory or retrograde urography reveals evidence of compression of the calices (Fig 498) and pelvis.

As to treatment removal of the fibrosclerotic or fibrolipomatous envelope is of no avail as long as the underlying infection of the kidney cannot be controlled.

CHAPTER 41

TUBERCULOSIS¹ OF THE URINARY TRACT

GENERAL CONSIDERATIONS

INCIDENCE, AGE, SEX, SIDE
 PATHOGENESIS
 ROUTES OF INFECTION
 ASSOCIATION OF RENAL AND GENITAL TUBERCULOSIS
 TYPES OF TUBERCLE BACILLI IN UROGENITAL INFECTIONS
 PATHOLOGIC CHANGES
 ACUTE AND SUBACUTE
 MILIARY FORMS
 CHRONIC FORMS

CHANGES IN OTHER PORTIONS OF THE URINARY TRACT

CLINICAL PICTURES
 CLINICAL PICTURES IN RENAL TUBERCULOSIS
 DIAGNOSIS
 ANALYSIS OF THE CLINICAL HISTORY
 EXAMINATION FOR EXTRARENAL TUBERCULOSIS
 UROLOGIC STUDY OR EXAMINATION
 TREATMENT OF RENAL TUBERCULOSIS
 NON-OPERATIVE TREATMENT
 OPERATIVE TREATMENT BY NEPHRECTOMY
 POSTOPERATIVE COMPLICATION
 BILATERAL CASES OF RENAL TUBERCULOSIS

GENERAL CONSIDERATIONS

In tuberculosis of the urinary tract, the primary localization of the infection is in the kidney. From here it is carried downward by the urine to the ureter, bladder and, less often, to the urethra. The only exception to this rule is when the infection, having already involved one kidney, extends to the other side by way of the bladder and ureter of the other kidney (see routes of infection).

INCIDENCE, AGE, SEX, SIDE

Renal infections constitute a large percentage of the diseases of that organ, hence it is of interest to note that Illyes reports (*Jour. d'Urol.* 1936, 42, 309) that 1071 (52.4 per cent) of 2043 operated cases of infection of the kidney observed at his clinic, were tuberculous.

Age Wildbolz states that the majority of cases are found between the ages of puberty and forty years. In 863 nephrectomies performed at The Mayo Clinic between 1894 and 1923, Judd and Scholl found that 85 per cent were in patients from 20-50 years old.

Illyes (loc. cit.) found that in 83.1 per cent of 1358 cases, the patients were between the ages of 20-40 years, thus

1-10	11	(0.8%)
10-20	108	(8.1%)
20-30	684	(49.9%)
30-40	448	(33.2%)
40-50	99	(7.4%)
50-60	5	(0.4%)
60-70	3	(0.2%)

Sex According to Wildbolz, there is no difference in the number of males and females, whereas Judd and Scholl, in 863 nephrectomies for renal tuberculosis, noted a predominance of males over females, i.e., 556 to 318 respectively. This is also true of the observations of Illyes, who reports 729 males to 501 females in 1,350 cases.

Sides Tuberculosis of the kidney clinically is a predominantly unilateral condition during the early period of its development. Illyes found a unilateral renal tuberculosis in 92 per cent of 1350 cases before operation. This diagnosis was confirmed at operation (nephrectomy) in 1071 (79 per cent) of the 1350

¹ The subject of Tuberculosis of the genitalia in the male is taken up in Chapter 20

cases The disease was bilateral in 107 (7.9 per cent) of 1305 cases. Wildbolz (Textbook 1934 edition) states that renal tuberculosis is bilateral from the onset in fifteen per cent of the cases seen clinically

Medlar (Wisc. Med Jour 1926 25 59) and more recently Band (Edinburgh Med Jour 1935 42 162) have found that the lesions are bilateral in the kidneys of individuals dying of pulmonary tuberculosis Such observations are of much interest from the standpoint of pathogenesis (see below) but of no clinical importance (see Pathology)

We shall discuss this question of bilaterality again under Diagnosis and Treatment.

PATHOGENESIS

ROUTES OF INFECTION

Hematogenous Route It is the consensus of opinion that in every case of renal tuberculosis except those to be mentioned under the second (ascending) heading the bacilli reach the kidney by way of its blood-vessels

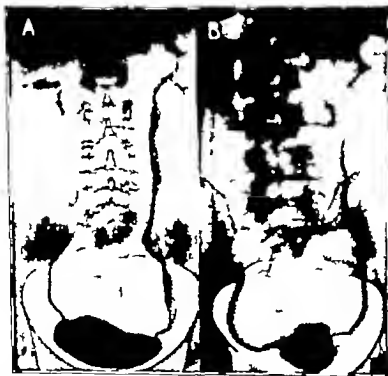


FIG. 500—Cystograms in two cases of renal tuberculosis with bilateral reflux. This illustrates one of the ways in which infection of the opposite kidney can occur. Note the small contracted bladder in case shown in B and the reflux into the ureteral stump after nephrectomy

Ascending Route When one kidney is infected by the hematogenous route the opposite one can be involved in one of the following ways

(a) By reflux of infected urine from the bladder into the ureter i.e. by a uretero-vesical reflux (Fig 500)

(b) By way of extension from the lymphatics of the bladder wall to those of the ureter as shown by Bauereisen.

(c) By way of the blood vessels of the second kidney into the general circulation i.e., from a focus in the primarily involved one or from some extrarenal focus

ASSOCIATION OF RENAL AND GENITAL TUBERCULOSIS

This occurred at an early stage, i e , both independently by the hematogenous route, in 10 per cent of the cases reported by Lee and Bowes (Brit Jour Surg 1934, 21, 83) and 12 per cent of those reported by McClelland (Canad Med Assn Jour 1933, November, 514) Genital tuberculosis secondary to established tuberculous renal infection has been noted in 30 per cent of cases by Young (Practice of Urology, 1926) and others The bladder is secondarily infected by both renal and genital tuberculous lesions

TYPES OF TUBERCLE BACILLI IN UROGENITAL INFECTIONS

The types of bacilli which act as causative organisms in both renal and genital tuberculosis are, in the order of their incidence, the human, the bovine and the avian

Two recent reports as to the relative incidence in renal tuberculosis are those of David Band (Edinb Med Jour 1935, 42, 162) and of Alston and Griffith (idem p 175) The former found the human type of tubercle bacillus in 21 and the bovine type in 10 patients with renal tuberculosis Alston and Griffith found about the same proportion of bovine type infections, viz 13 (30.9 per cent) of 42 cases As to the avian type, it is very rarely found clinically Katz (Jour d'Urol 1931, 31, 18) reported a case of renal and another of epididymal tuberculosis due to the avian type

Loewenstein and, more recently, Carl maintain that the avian type of infection gives rise to a clinical picture like that of a generalized sepsis R Welti (Zeit Urol Chir 1933, 38, 115) states that there is no characteristic clinical picture and that the only criteria of an avian type of infection are (a) the appearance of the cultures on various mediums, (b) the skin reactions, and (c) the results of animal inoculation

Differentiation of Tubercle Bacilli Each of the three types, human, bovine and avian can be distinguished by the appearance of the growth on culture media and by their pathogenicity for guinea-pigs, rabbits and fowl Both the human and bovine types are pathogenic for guinea-pigs and rabbits, the bovine more so for rabbits than the human type, but not so for fowl The avian type is nonpathogenic for guinea-pigs but the intravenous injection is followed in 5-7 months by an osseous and polyarticular tuberculosis with absence of visceral lesions The subcutaneous inoculation of a fowl with the avian type gives rise to a generalized infection In 61 cases studied at the Wildbolz clinic, Welti was only able to find an avian infection in two and even in these, although the growth was considered typical for the avian type, the conclusion was reached that the infection in the two cases was due to an atypical strain of the human type of bacillus

PATHOLOGIC CHANGES

Those of the kidney are found in one of the following forms

- 1 The acute and subacute miliary type of infection
- 2 The chronic type of infection

ACUTE AND SUBACUTE MILIARY FORM

These are of little clinical interest because they either form part of a generalized miliary infection or occur as a terminal process in cases of pulmonary



FIG. 501.—Gross and histological lesions in incipient renal tuberculosis. A. Incipient ulcerative tuberculous lesion of papilla as seen with aid of a magnifying glass. B. Microphotograph of same lesion. Very early lesion with tiny ulcer and numerous giant cells. (Courtesy of Drs. Dimiza and Schaffhauser of Zurich, Switzerland.)

tuberculosis. In either case the renal infection is indistinguishable from the symptoms incident to the generalized or pulmonary localizations.

In the acute and subacute forms the tubercles are almost invariably found in relation to the glomeruli of the renal cortex. They are usually bilateral as both Medlar (Amer Jour Path 1926 2:5) and Band (loc cit) have shown in patients dying of pulmonary tuberculosis. Some of these tubercles become fibrosed, i.e. heal spontaneously. In the examination of the kidneys of 150 rabbits inoculated with the bovine type of tubercle bacillus the tubercles were also found to be bilateral and cortical.

CHRONIC FORMS

These include

- (a) Caseocavernous type (Figs. 503, 505, 511 and 515)
- (b) Disseminated nodular type
- (c) Fibrous or indurative type
- (d) Tuberculous nephritis.

The Caseocavernous Type

This is found in the majority of clinical cases.

EARLY STAGE The appearance of the surface of the kidney does not differ



FIG. 502.—Microphotograph of a primary subcortical lesion with epithelioid cell focus and streaky round-celled infiltration of papilla in incipient renal tuberculosis. (Courtesy of Drs. Dimiza and Schaffhauser of Zurich, Switzerland.)

from that of the normal organ. The early changes are only to be seen on section of the kidney, in the form of minute ulcerations (Figs 501, 502 and 514) on the surface of the papillae or in the point of reflection, termed niche, of the mucosa in the minor calices. Lieberthal and von Huth (*Jour Urol* 1933, 30, 153) state that small ulcers on the papillae are often missed because the individual calices are not exposed to their termination. These ulcers are often so minute that it is necessary to use a magnifying glass to detect them. One should always make serial sections of areas where the mucosa presents a greyish discoloration or



FIG 503—Operative specimen from case of extensive tuberculous involvement of lower half of kidney. Only symptoms were those of a chronic cystitis.

minute erosions in cases in which early ulceration is not found. Often the tuberculous focus is still submucous and only visible on histological study in these early cases.

MORE ADVANCED STAGE The infection which began on the surface of the papillae now extends into the medulla and then into the cortex. More and more papillae show evidences of ulceration (Figs 501 and 514) and one sees cavities whose lining presents a necrotic caseous appearance (Fig 511). Some of these cavities communicate with the pelvis, others do not or only indirectly. We will refer later to the intermittent discharge of tubercle bacilli into the urine as a result of alternate closure and reopening of the communication between the cavities in some cases and the renal pelvis.

The surface of the kidney now begins to show evidences of the spread of the infection from the medulla into the cortex. Tubercles either having a dull greyish appearance or already yellow because of caseation, stand out as single

or grouped nodules. In some areas, the surface is bosselated because of cavities lying close to the capsule (Fig. 504). The spread of the infection from the primary

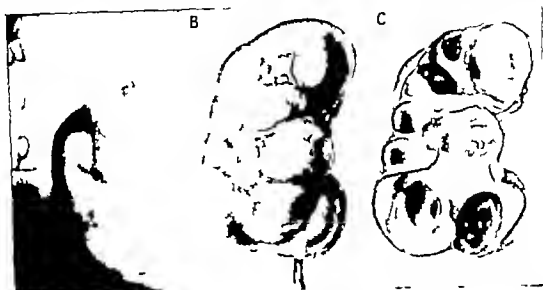


FIG. 504.—Case of bilateral renal tuberculosis in which patient remained apparently in good condition for nearly seven years after removal of huge tuberculous pyonephrosis weighing ten pounds and shown in B and C.

A Pyelogram of opposite kidney showing extensive destruction at time of above nephrectomy

foci in the papillae to other parts of the kidney takes place by way of the tubules as well as by means of the blood vessels and lymphatics.

TERMINAL STAGE. The kidney loses its normal bean-shaped outline and the surface becomes a series of elevations and depressions (Figs. 504 and 505) i.e. the bosselation as it is termed becomes very marked. Very few tubercles are now to be seen and the kidney may become enormously enlarged. The size depends to a great extent on whether the tuberculous pyonephrosis is able to expel the caseous contents of its cavities into the renal pelvis.

TUBERCULOUS HYDRONEPHROSIS. In many cases instead of seeing on section an appearance like that of Fig. 514 i.e. a tuberculous pyonephrosis, one may find simply the entire parenchyma replaced by a series of cavities (Figs. 504 and 505) filled with turbid urine. The term tuberculous hydronephrosis is applied to this type of terminal stage.

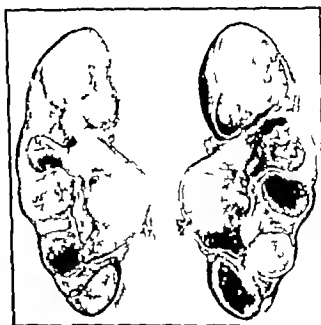


FIG. 505.—Operative specimen of tuberculous kidney illustrating results of early occlusion of pelvic outlet with development of hydronephrotic trophism of parenchyma.

OCCLUDED TUBERCULOSIS (AUTONEPHRECTOMY). In some patients as the result of closure of the outlet of the renal pelvis by specific inflammatory changes

and subsequent cicatrization, the tuberculous pyonephrosis ceases to communicate with the ureter and the term occluded tuberculosis is applied. These are the cases which are supposed to have recovered because tubercle bacilli and pus are no longer found in the urine. The term autonephrectomy is also used for these occluded pyonephroses. They continue to be a menace to the patient, because of the constant danger of a generalized miliary tuberculosis due to the presence of still virulent bacilli in the caseous contents of the cavities.

THE INVOLVEMENT OF THE FATTY CAPSULE results in the same sort of changes as were described in cases of chronic nontuberculous pyelonephritis (Chapter 39). We have encountered cases in which the capsule was half an inch in thickness, as the result of inflammatory changes, in tuberculosis of the kidney.

At times, a mixed infection of nontuberculous and tuberculous character is observed, the pus showing on smear and culture both the *Staphylococcus aureus* and the tubercle bacillus. The clinical picture in these mixed infection cases often resembles closely that of an acute nontuberculous pyelonephritis (Fig 506).

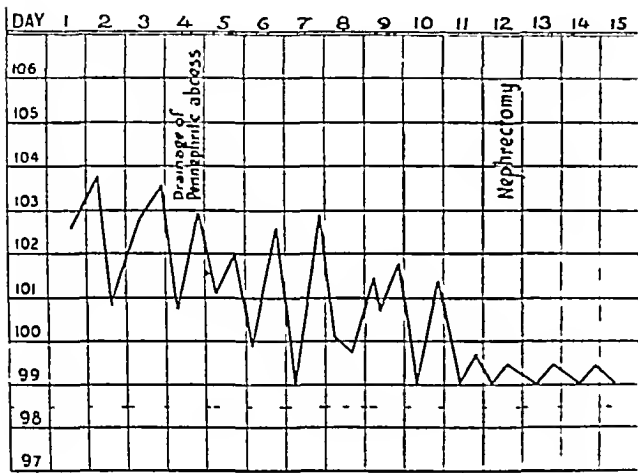


FIG 506—Temperature chart in case of mixed nontuberculous and tuberculous renal infection. Note transitory fall of temperature after opening of perinephritic abscess in pus of which both staphylococcus aureus and tubercle bacilli were found.

The Disseminated Nodular Form

This is rare. In 1000 nephrectomies for renal tuberculosis Wildbolz only found it in 6 or 7 cases. The chief distinguishing feature is the absence of cavity formation in spite of the development of numerous areas of conglomerate tubercles in the cortex and medulla. The clinical course is a very slow one and not

apt to give rise to a miliary tuberculosis as formerly taught.

The Fibrous or Indurative Form

Here neither cavity formation nor caseation take place. The outstanding feature is widespread fibrous tissue changes not only around the few tubercles to be found in this form but in the intertubular spaces so that the histologic picture is like that of a chronic interstitial nephritis.

Tuberculous Nephritis

There is still a lack of unanimity of opinion as to whether this form exists. Wildbolz maintains that as the result of a tuberculous infection, nonspecific inflammatory changes can take place, and that tubercle bacilli will be found in the urine, although no tubercles have developed in the kidney and tubercle bacilli can only rarely be seen after hundreds of serial sections have been stained. Dimtza and Schaffhauser as well as von Huth and Lieberthal take issue with this opinion of Wildbolz and maintain that a tuberculous nephritis as defined by him does not exist.

CHANGES IN OTHER PORTIONS OF THE URINARY TRACT

These appear quite early in some cases and late in others. Tubercles appear on the mucosa of the renal pelvis at first near the papillae and soon all over the surface. Some break down and form ulcerations on which calcareous deposits may take place. Similar specific (tuberculous) changes are observed on the mucosa of the ureter. In some cases the infection extends to the other coats of the ureter with resultant stricture formation, so that the possibility of such an etiology must always be kept in mind in ureteral stricture. The invasion of the ureteral wall is so marked at times that it can be felt as a hard fibrous cord per vaginam or at operation is found to be the size of the adult little finger. The changes in the ureteral orifice and bladder will be discussed under cystoscopic diagnosis.

CLINICAL PICTURES

The chief clinical feature of urethral tuberculosis secondary to renal or genital tuberculosis is the tendency as in the case of the ureter to stricture formation. Richter (*Acta Chir Scand* 1925 59:237) reported two cases of generalized miliary tuberculosis following the dilatation of such a stricture.

RENAL TUBERCULOSIS IN CLINICAL PICTURES

In nearly every case of tuberculosis of the urinary tract, there is a single or a closely allied group of complaints for the relief of which the patient has come to the physician. In order to simplify the subject, we believe that it is advisable to take up the clinical pictures under which renal tuberculosis and its sequelae appear rather than to begin with a description of individual symptoms. A glance at Fig 307 will aid in understanding this division into clinical pictures. These will be first enumerated and then taken up in detail.

- 1 Disturbances in the act of urination
- 2 Sudden initial painless hematuria
- 3 Dull pain over kidney or initial typical ureteral colics
- 4 Initial symptoms of acute or chronic renal infection indistinguishable at first from those due to nontuberculous infection.
- 5 Discovery of a mass over the kidney region without symptoms referable to the urinary tract.

Let us consider these separately.

Disturbances in the Act of Urination

This clinical picture constitutes at least 75 per cent of all of those which renal tuberculosis presents. As a rule the individual symptoms appear gradually, increasing in severity over a period of months to years. They are

(a) FREQUENCY i.e., an increased desire to urinate. The history of the mode of onset is often as follows. The patient has noticed that a few months ago, perhaps longer, there has been an increase in the number of times he or she experienced the desire to void urine. This may have occurred only at night i.e. nocturia, or during the day. With night workers, the opposite of course is true

Gradually the frequency increased so that instead of being obliged to void perhaps once or twice during the night, he is obliged to get up almost every hour. During the day this desire to empty the bladder has gradually increased, until the intervals are reduced to fifteen to twenty minutes. This combination of frequency during the night or nocturia, and of the same bladder symptom during the day, is termed diurnal frequency.

At the onset, the patient states that he (or she) could wait when the desire to void was felt, but that as the frequency increased, so did the inability to control the emptying of the bladder, until in some cases, the urgency becomes imperative i.e. the moment the desire to void arises, the urine must be passed or incontinence ensues. In children and young adults, incontinence is often the only complaint. We recall a case in which a boy of sixteen was referred because of this symptom, which had existed for several months. As soon as he passed markedly turbid urine, full of pus, it was evident that the incontinence was not of a functional nature.

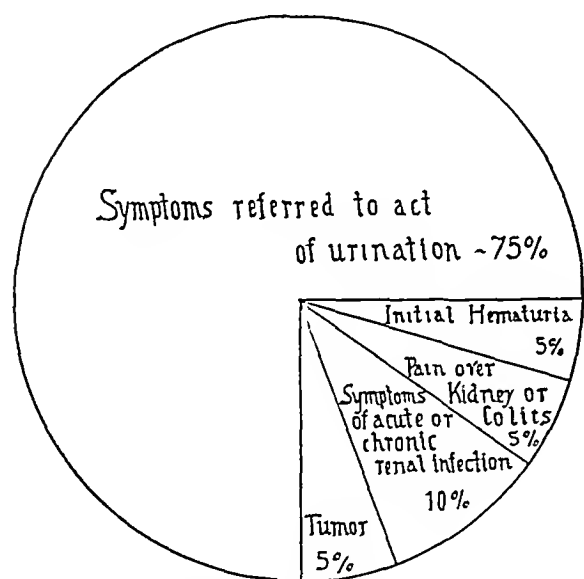


FIG. 507.—Relative frequency of the outstanding symptoms (see clinical pictures) in renal tuberculosis. Note predominance (75%) of those with symptoms of cystitis.

membranous urethra, so that the symptom spoken of as tenesmus, appears. The patient states that hardly has he (or she) made the effort to empty the bladder and experienced excruciating pain, both during and after the act, than there is a recurrence of the same cycle at such frequent intervals, that life seems intolerable. Often this tenesmus (formerly called strangury), is accompanied by the expulsion of a few drops of blood.

The visible bladder changes are often out of all proportion to the subjective symptoms. This is true especially of frequency as will be referred to later, in the section on cystoscopy in renal tuberculosis. In the later stages, when ulceration at or near the vesical neck is common, it is not difficult to understand how this reflex arc is stimulated and the exposed nerve endings cause painful sensations to be transmitted to higher centers.

Pain over the bladder, independent of urination, is uncommon. One can often elicit tenderness on suprapubic pressure, but this is of little diagnostic value.

(b) PAIN ON URINATION. Some patients will give a history of pain accompanying the frequency, from the onset. This is exceptional. The usual sequence of events is, that after several months of the above described increased desire to void, the act of urination is either preceded, accompanied or followed by pain. At first, this is not severe, but as the changes develop in the vicinity of the bladder neck, the pain before, during or after each urination becomes the outstanding feature of the patient's complaints, no matter whether the primary focus is in the kidney or in the genital tract. The irritation at the vesicle neck may give rise to reflex spasm of the vesical sphincters at this point and in the

As the bladder symptoms develop the capacity decreases so that even the presence of 50 to 100 cc gives rise to the desire to void. This intolerance is at times reflex but in general is due to local bladder changes and may (see end results) continue for months, even years after removal of the involved kidney. It is due to changes resulting in the so-called "contracted bladder." The persistence however of bladder symptoms after operation should always lead to the suspicion of an involvement of the remaining kidney. This intolerance of the bladder to fluid is the cause of the incontinence so often complained of, in the history given by advanced cases. It is an important factor as we shall see in making cystoscopy a most difficult and at times impossible procedure. The intolerance of a tuberculous bladder to silver preparations is a feature which should always be noted in taking a history.

When one takes into consideration the observation that at least 75 per cent and in the opinion of one urologist² 85 per cent of all cases of renal tuberculosis come to the physician with the history of bladder symptoms, the necessity of keeping in mind the possibility of such an underlying cause cannot be overemphasized.

Hematuria as the Outstanding Clinical Feature

This is the first symptom in about five per cent of all cases although it accompanies the vesical symptoms in a much larger number at some period or other in the evolution of the disturbances referable to the act of urination.

There is as little which is pathognomonic about such as an initial hematuria in renal tuberculosis, as there is about so many other sudden, severe, symptomless hematurias. One may find upon careful questioning that there were prodromal symptoms referable to the urinary tract, but as a rule these are absent. If the bleeding is profuse the onset may be accompanied by pains (due to the passage of worm-like clots) which simulate those incident to the movement of ureteral calculi. Occasionally a search for tubercle bacilli during such a hematuria may be successful but this is rare. In one case we made a diagnosis of a probable renal neoplasm from the pyelographic finding and were surprised (the urine having been negative for tubercle bacilli) to find an incipient renal tuberculosis (Fig 501).

Dull Pain over the Kidney or Ureteral Colic

This group includes about five per cent of all clinical pictures. There is also nothing characteristic about either of these symptoms and only a thorough urologic study (see diagnosis) will enable one to interpret such complaints.

Initial Symptoms Indicative of Acute or Chronic Renal Infection

An onset, with symptoms usually considered to be typical of an acute pyelonephritis i.e. (a) fever of the so-called "steep" type with or without accompanying chills (b) pain or tenderness (on pressure) over the involved kidney (c) enlargement of the kidney is rarely seen in renal tuberculosis. One must however keep in mind, the frequent observation that such a syndrome (group of symptoms) may be due to an abscess in the perinephric tissues (see Pathology). These more acute manifestations are as a rule the result of a mixed infection (with the ordinary pyogenic organisms) and may resemble in every respect the acute mode of onset in non-tuberculous infections of the kidney and its envelopes. In the case whose chart is shown in Fig 506 there was no suspicion of such a mixed infection until smears from the pus of what was considered to be an ordinary non-tuberculous perinephritic abscess revealed the presence of tubercle bacilli as well

as staphylococci. Some authors maintain that such an onset (with perinephric abscess) is the most common one in children, but this observation is not the experience of the majority of other urologists.

In regard to the more latent, i.e. chronic types of renal infection, we cannot urge too strongly, to search for a possible underlying tuberculosis, in every case of persistent renal infection, if calculus can be excluded. A fistula or so-called "cold" abscess appearing over the kidney region may be the first sign of a renal tuberculosis. If the bony structures can be excluded, the kidney must be thought of as the next most common cause.

Mass over the Kidney Region

In a few cases, the discovery of a mass in the kidney region, in a patient who is complaining of a loss in weight, lack of appetite and inability to pursue his (or her) ordinary occupation with the usual energy, has led to an examination of the urinary tract. As in the case of all of the clinical pictures just outlined, there is nothing characteristic about such an enlargement in the kidney region. It may be due not so much to an enlargement of the kidney itself, as to an enormous thickening (Fig. 718) of the tissues around it. This as we have stated in the section on pathology of renal tuberculosis, is equally true of nontuberculous infections. The enlarged kidney may be on the side opposite to that of the tuberculous infection, as the result of compensatory hypertrophy. This shows that the mass palpated in the kidney region is of some help, in at least leading to a thorough urologic study, but cannot be relied upon as indicative of a renal tuberculosis alone.

To sum up, all of these clinical pictures must be considered in taking the history, but to none of them can be ascribed any specific diagnostic value. The occurrence of bladder symptoms in 75 to 85 per cent should impress the physician who first sees cases of renal tuberculosis, with the necessity of more thorough examination as to the underlying cause.

DIAGNOSIS

This is based on the following data:

1. Analysis of the clinical history
2. Results of examination for extrarenal tuberculosis
3. The urologic study

ANALYSIS OF THE CLINICAL HISTORY

Two features of the clinical history of cases of renal tuberculosis must be constantly kept in mind. These are, first, that 83 per cent (Illyes) of these patients are between the ages of twenty and forty, and second, that in over 75 per cent, the syndrome (frequency of urination, pain on urination and pyuria) indicates some bladder rather than a kidney infection. Hence, when individuals between these ages complain of symptoms referable to the bladder, no time should be lost in having a complete urologic examination made to exclude a renal tuberculosis. But it is not only during the third and fourth decades of life that this type of infection is found, but even in children (see Chap. 46) and less often after the age of forty. None of the chief complaints of the patient enumerated under clinical pictures has any feature which is pathognomonic for renal tuberculosis. The disturbances in the act of urination, a sudden symptomless hematuria, dull or colicky pain over

the kidney and ureter regions, symptoms of acute or chronic pyelonephritis and enlargement of the kidney are not only found in nontuberculous infections of the urinary tract, but in many other conditions. The only way to interpret the clinical history of a case of renal tuberculosis is to think of it when for example an acute or chronic infection of the urinary tract does not reveal the presence of gram negative and -positive bacteria and shows no improvement following appropriate treatment for nontuberculous infection. We shall discuss a little further on the existence of acute and chronic syndromes like those seen in ordinary non-tuberculous infection but in whom no bacteria are found on stain culture or animal inoculation of the urine or where so few are present as to fail to convince the urologist that the clinical picture can have any relation to such a paucity of bacteria (usually staphylococci and streptococci). Even in these cases of abacterial or amicrobial pyuria it is necessary to exclude a renal tuberculosis.

To sum up given a young individual who complains of symptoms referable to the urinary tract but in whose previous history one cannot find any source of infection the possible existence of a renal tuberculosis is one of the first diseases to be ruled out.

EXAMINATION FOR EXTRARENAL TUBERCULOSIS

This should be carried out in a systematic manner. To exclude a pulmonary tuberculosis plain radiography is by far the most rapid and exact method of examination. We know that the majority of urogenital tuberculous infections are secondary to mediastinal and bronchial lymph node foci but especially to pulmonary foci. To advise operation

in moderately severe or advanced pulmonary tuberculosis is not good surgical judgment hence radiography of the chest is one of the first steps in the search for extrarenal foci. Next one should examine the peripheral lymph nodes the skin and above all take into consideration the existence of a bone or joint lesion in which a tentative or positive diagnosis of tuberculosis has been made.

THE UROLOGIC STUDY OR EXAMINATION

Special attention in cases of suspected renal tuberculosis should be paid to the following



FIG. 508.—Urographic deformity due to tuberculous perinephritic abscess. Note how opaque medium has escaped from renal pelvis into tissues around upper pole. The urographic deformity resembles that observed in neoplasms.

- 1 Palpation of the kidney, examination of the genitalia in both sexes
- 2 Cystoscopy, ureteral catheterization and determination of renal function
- 3 Plain radiography and urography (excretory and retrograde)
- 4 Examination of the urine

We shall discuss these various steps in making a diagnosis, in the order named

1 Palpation of the Kidney and Search for Concomitant Genital Tuberculosis

Palpation of the kidney is of little help in the early cases, where such an enlargement of one kidney could confirm the findings of the instrumental and bacteriologic examinations. Not until the disease is fairly well advanced does the kidney appear larger on bimanual palpation (Fig 549). Examination for evidences of tuberculosis of the epididymis, prostate and seminal vesicles and for tuberculous salpingitis only requires a very short time and may yield much valuable information. We have already referred under Pathogenesis to coincident renal and genital tuberculosis in the male.

2 Cystoscopy, Ureteral Catheterization and Determination of Renal Function

If one suspects the presence of a tuberculous cystitis, it is advisable to employ caudal anesthesia (see Chap 9) before making any attempt to introduce a cystoscope. Intermittent irrigation as explained in Chapter 6 may prove to be indispensable if the field is constantly obscured by efflux of pus or blood from a tuberculous kidney.

One encounters three groups of cases at cystoscopy:

1 Those cases in which the bladder mucosa appears normal or only slightly hyperemic (C of Plate II)

2 Those cases in which the appearance of the mucosa is like that of a nontuberculous infection (D, E and F of Plate II)

3 Those cases in which specific tuberculous changes are present. In this group are included tiny tubercles with a greyish white centre and red peripheral zone. These are most often to be seen on the posterior wall of the bladder or close to one of the ureteral orifices (E of Plate III). Search for tubercles on the anterior wall must not be omitted because they are at times found only in that portion of the mucosa. Ulcers of irregular outline and with sharply demarcated edges are often present and close to them tubercles may be seen.

The lips of the ureteral orifice may be normal or edematous in the early stages of a renal tuberculosis. When only edema or gaping exists, there are no distinguishing characteristics from the edema seen in nontuberculous infections (F of Plate X). Later on, the lips of the ureteral orifice on the involved side in renal tuberculosis, appear to be the seat of a type of edema, termed "bullous edema" (D of Plate X) which is very rarely observed in nontuberculous renal infections. When tubercles are visible near such an orifice and the latter appears to be retracted, termed golf-hole orifice, the diagnosis of the tuberculous character of the lesions is not difficult.

If one hesitates to pass a ureteral catheter on the noninvolved side, much information can be obtained watching the corresponding ureteral orifice following the injection (intravenous) of indigocarmin (see Chap 8). The efflux of faintly blue stained urine (C of Plate XII) within 2-5 minutes following intravenous

administration of the dye and the rapid change (within a minute) to an intense blue indicate a good functioning opposite kidney. This test can be corroborated by estimation of the blood urea.

The collecting of specimens of the ureteral urine for chemical microscopic and bacteriologic examination from the diseased and if possible also from the noninvolved side following ureteral catheterization, should form a part of the routine study of every case. We will take this up again in the section on examination of the urine.

3 Plain Radiography and Urography

A film exposure and excretory urography should be carried out in every case. In a recent paper by one of us (Surg. Gynec. and Obst. 1935, 60-77) on Renal Tuberculosis and Nephrolithiasis as Associated Diseases the various types of shadows seen on the plain film were reviewed.

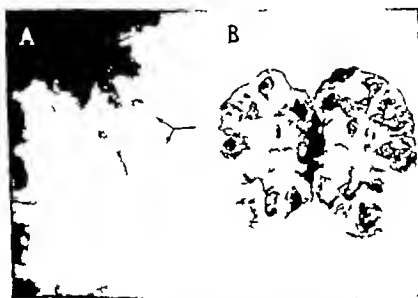


FIG. 509.—A. Multiple shadows of calculi in tuberculous kidney. Note characteristic lighter centers and dark periphery of calculi found in tuberculous infection.
B. Kidney of same case with incrustations (soft phosphatic) lying in the cavities.

It is necessary in the interpretation of shadows seen on the plain film to make a distinction between calcification in a tuberculous kidney and true calculus formation as an associated disease. In the former as Crenshaw (Jour. Urol. 1930, 23-515) has shown there are (a) multiple scattered small areas due to lime deposits (b) single or several larger isolated areas of calcareous deposits (Fig. 509) often of a density and contour suggestive of calculus, and (c) large regular round more diffuse shadows of variable density so that in advanced cases the shadows may assume the outline of a complete cast of the kidney (Fig. 510) irregularly divided into lobules.

In the case of true calculus formation of which 40 published cases were collected up to 1935 the shadows do not differ in density or contour from those of calculi in nontuberculous cases.

If the association of tuberculosis and nephrolithiasis is overlooked a peritonitis will follow the nephro- or pyelolithotomy.

EXCRETORY (INTRAVENOUS) UROGRAPHY has thus far not proved to be of much diagnostic aid in the early stages of renal tuberculosis. The same criticism can be

made here as in nontuberculous infections and in neoplasms, that little information is obtained as to the finer changes in the minor calices. At a more advanced stage, one can often make a diagnosis of a pyonephrosis by the presence of multiple, more or less oval, scattered shadows

FIG 510



FIG 511



FIG 510—Typical shadow of so-called “putty” kidney on the right side. The tuberculous kidney has been converted into a number of cavities filled with caseous material in which calcification has taken place.

FIG 511—Tuberculous pyonephrosis accompanied by calculous formation. Note relatively large calculus filling renal pelvis.

Papin and de Berne Lagarde (Jour Belge d Urol 1935, 8, 297) reported a series of 86 cases in which excretory urography was used. They placed the 86 cases of renal tuberculosis in three groups



FIG 512—Pyelograms from cases of renal tuberculosis

A Note irregular moth eaten outline of shadow

B Isolated marked dilatation of one calyx and to lesser extent of other calices. Note ureteral dilatation

C Marked dilatation of an upper calyx

As explained in text, there are few changes in the pyelogram which are pathognomonic of renal tuberculosis

GROUP I URETERAL CATHETERIZATION IMPOSSIBLE ON BOTH SIDES

Twenty-four cases showing large cavity formation, in one case on both sides

GROUP II URETERAL CATHETERIZATION IMPOSSIBLE ON ONE SIDE

Thirty cases. In 19 of these ureterectasis and pyelectasis accompanied by cavities with irregular borders was seen. There was absence of visualization in six cases.

GROUP III URETERAL CATHETERIZATION POSSIBLE ON BOTH SIDES

In 20 of the 21 cases in this group excretory urography confirmed the clinical diagnosis of renal tuberculosis.

The conclusion reached in this report was that ascending (retrograde) urography was preferable if one wished to have a clear picture with sufficient details upon which to base a diagnosis.

ASCENDING (RETROGRADE) UROGRAPHY is limited to the cases in which ureteral catheterization is possible. We believe it should only be employed on the involved side. The changes seen by this method in the urogram are shown in Figs 512. The peculiar moth-eaten (A of Fig 512) appearance of the shadows is an indication of ulceration of the papillae. In other cases, cavity formation can be interpreted by a large shadow often with irregular borders limited to a major calyx (B and C of Fig 512). In advanced cases, i.e. tuberculous pyo- or hydronephrosis the urogram greatly resembles that of nontuberculous cases (Fig 465). In some moderately advanced cases the ureterectasis is quite noticeable (B of Fig 512). We consider ascending urography a valuable diagnostic aid in renal tuberculosis.

4 Examination of the Urine

ORDINARY CHEMICAL AND MICROSCOPIC EXAMINATION. This should be especially directed toward a search for albumin, casts, hematuria and leukocytes. If more than a trace of albumin is found this indicates a toxic condition of the noninvolved kidney which disappears rapidly following removal of the tuberculous one. A true nephritis in the latter was found by Wildbolz in only 2 per cent of his cases; the clinical symptoms not differing from those seen in other cases of nephritis (see Chap. 44).

The normal urine shows 5-7 leukocytes per high power field. Any number above this can be regarded as a pyuria in which the leukocytes vary from 20-30 to a high power field to so many that they cannot be counted. Pyuria decreases in function and tubercle bacilli are according to Wildbolz the triad without which a diagnosis cannot be made. Aside from cases of occluded lesions (see Pathology) in which there is an absence of pyuria there may be a similar condition in incipient cases so that this triad is not infallible.

BACTERIOLOGIC EXAMINATION OF THE URINE. If possible only urine obtained by ureteral catheterization should be utilized. Papin reported a case in which a tuberculous salpingitis ruptured into the bladder (Fig 513) but this is a rare source of error. In tuberculosis of the male genitalia secondary extension to the bladder is not infrequent but even if this has not taken place only a ureteral urine is of value because of the likelihood that tubercle bacilli from the genital foci are discharged into the bladder urine. In an earlier chapter (8) the

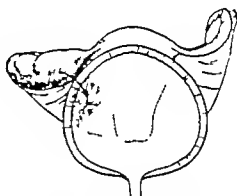


FIG 513.—Diagram to illustrate the perforation of a tuberculous pyosalpinx into bladder (Papin).

technic of the smear, guinea-pig inoculation and culture methods of finding tubercle bacilli was discussed, so that we shall limit ourselves here to their comparative value³ as follows

A SMEARS AS COMPARED TO CULTURES

In a total of 424 cases of renal tuberculosis which we have collected, the culture was positive in all, but the smear positive in only 351, a difference of nearly 16 per cent. This confirms the observation of de Carvalho that a smaller number, 1 to 10, of tubercle bacilli is necessary to obtain a positive culture, whereas in the case of smears from 10 to 10,000 must be present to be positive.

In addition to the above comparison, another should be cited, that of Fischer and Urgoit. The smear was found positive in only 25 (12.3 per cent) of 308 patients who were examined for suspected renal tuberculosis, whereas the culture was found positive in 106 (46 per cent) of 227 in whom it was employed.

B CULTURES COMPARED TO GUINEA-PIG INOCULATION

We were only able to find reports of 124 cases in which this comparison was made. Of this number, there is less difference between the two methods, the cultures being positive in 61 and the guinea-pig inoculation positive in 55 cases.

C COMPARISON OF SMEAR, CULTURE AND GUINEA-PIG INOCULATION

Seidman found both the smear and culture negative and the guinea-pig inoculation positive in 15 cases. In seven urine specimens examined by Hirschberg, the smear and guinea-pig were negative and the culture positive. In two other cases, only the smear was positive, the other two negative. In the seventh case, the smear was negative but the other two positive. The largest number of cases in which the three methods were compared, is that of Dimtza. In 81 cases, the smear was only positive in 58, the guinea-pig inoculation positive in 76 and the cultures positive in 80.

We have mentioned these comparisons of the three generally employed methods of search for tubercle bacilli for the reason that although the smears, with correct technic, are positive in 85-90 per cent of the cases, the other two methods are at our disposal either to check up on positive smears or to find the tubercle bacilli in the 10-15 per cent of cases in which the smears are negative. In the latter group of cases, both the culture and guinea-pig method should be employed. The former has the advantage, that a positive result can be obtained as early as the fifth day after inoculation of the medium. The average period at which colonies are visible is from 12-14 days, whereas it is necessary to wait at least six weeks before killing a guinea-pig to see if the animal has been tubercularized, unless it dies sooner. Two objections raised against the guinea-pig inoculation test are, first, the development of a spontaneous tuberculosis, and second, death from intercurrent infections. If guinea-pigs are employed, it is necessary to inoculate two animals, because one may become tubercularized and the other not.

ABACTERIAL OR AMICROBIC PYURIA Until recently, the presence of a pyuria, in which no bacteria could be found in smears, cultures and guinea-pig inoculation, was considered to be pathognomonic of a renal tuberculosis and a number of nephrectomies were done on the basis of such an abacterial pyuria. The importance of a knowledge of the existence of a clinical entity in which pyuria is a prominent finding and yet only an insignificant number of, or no, bacteria are

³ For further details see Collective Review by one of us (Eisendrath) in the International Abstract of Surgery, forming part of the August 1937 number of Surgery, Gynecology and Obstetrics.

found cannot be sufficiently emphasized in connection with the diagnosis of renal tuberculosis. Schaffhauser (*Zeit Urol Chir* 1937 43, 83) has subjected the reported cases of amicrobic pyuria to a critical analysis and added 19 cases observed at the clinics of Wildbolz and of Clairmont. The onset is as a rule, sudden with predominance of symptoms referable to the bladder such as frequency, tenesmus, microscopic or gross hematuria and pyuria. The last named soon becomes the outstanding feature of the case. Ten of the twenty two published cases had unilateral pyuria. There are two types of cases: the Soderlund, in which there is no history of any preceding infection and a second one in which the abacterial pyuria represents a stage in an acute or chronic nontuberculous pyelonephritis.

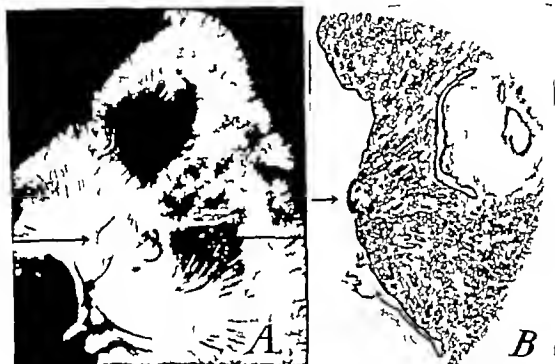


FIG 514.—Gross and histological lesions in incipient tuberculosis of renal papilla. (Courtesy of Drs. Dumitru and Schaffhauser of Zurich, Switzerland.) A. Gross appearance (with aid of magnifying glass) of pin-head sized non-cased granulation area of a papilla (arrow on right points to area better than arrow on left). This lesion was the only one found in the kidney. B. Microphotograph of same lesion. Arrow points to the pin-head sized subepithelial non-cased granulation area, the only tuberculous lesion in the kidney.

The prompt clearing up of the pyuria following the intravenous administration of nearsphenamine as suggested by Wildbolz is one of the chief aids in distinguishing such a pyuria from that found in renal tuberculosis. The etiology of this peculiar clinical entity is still obscure.

TUBERCLE BACILLURIA. The term tubercle bacilluria may be defined as the presence of tubercle bacilli in the urine of patients whose kidneys fail to reveal any specific tuberculous changes on gross histologic and bacteriologic examination. According to those who support the theory that a true tubercle bacilluria exists, the bacilli must (a) have passed through a normal kidney (b) through one damaged from nontuberculous inflammatory changes or (c) through a kidney showing histologic changes of a nonspecific type as claimed by Wildbolz, which characterize tuberculous nephritis. Those who oppose true tubercle bacilluria as a clinical entity demand before a given clinical case can be placed in this category that the following criteria must be fulfilled:

1 Every known method must have been employed to show that the kidney is normal in function and free from pathologic changes

2 Not only must the urine which is to be examined be collected by ureteral catheterization, but the presence of a genital tuberculosis in the male or the discharge of a perivesical tuberculous focus in the female into the bladder, must be excluded

3 A single method of examination does not suffice. The smear, culture and animal inoculation methods must all be used, because if the acidfast bacilli found in the urine are nonpathogenic for guinea-pigs, rabbits and fowl they are acidfast saprophytes

4 Every case must have been subjected to a complete urologic study, including excretory and, if possible, ascending (retrograde) urography

5 Gross inspection of the kidney for minute foci (Fig 514) should be carried out according to the technic described by Dimtza and Schaffhauser and also by Lieberthal and von Huth. Histologic study must include serial sections of suspected tuberculous areas. The kidney tissue, as obtained at necropsy, must give negative results by the smear, culture and animal inoculation methods before the presence of a renal tuberculosis can be excluded

A true tubercle bacilluria⁴ does not exist, as an impartial review of the evidence in favor and against such an occurrence reveals. The presence of tubercle bacilli in the urine signifies a specific lesion, the ability to demonstrate it by clinical and laboratory methods is possible in practically all cases provided that the case can be kept a sufficiently long time under observation

TREATMENT OF RENAL TUBERCULOSIS

NONOPERATIVE TREATMENT

Amongst the methods which have been employed are tuberculin injections, helio- and climatotherapy, irradiation and serums. No proofs have been submitted of a single case cured by any of these methods according to Wildbolz (1934)

The next question which presents is, can spontaneous healing of lesions take place?

The histologic examination of the kidneys, by Medlar and by Band, in cases of pulmonary tuberculosis show that tuberculous lesions are to be found, on histologic examination, in a certain number, if the serial section method is employed. The tubercles are usually bilateral, cortical and so small as not to give rise to clinically demonstrable findings. Such lesions have been shown by both of these authors, to become fibrosed, i.e., they can heal spontaneously. This raises the question as to whether caseating foci can also heal. This would mean that clinical cases exist in which tubercle bacilli were found on one or several occasions in the urine, a genital source being excluded, and then were absent over a period of one or more years, which would justify the conclusion that caseous focus had existed but had healed. This viewpoint is expressed by Harris, by Band and others, to explain the absence of the bacilli on later examinations. The chief argument

⁴ See Collective Review by one of us (Eisendrath) on Tubercle Bacilluria, its interpretation by present day methods of investigation, which appeared in International Abstract of Surgery (Surg Gynec and Obst January 1938)

against such a claim is that not only in many clinical cases of renal tuberculosis is the evolution of the lesions subject to great variation in respect to time but also that a focus may become temporarily or permanently occluded and yet the destructive process continues in the form of an autonephrectomy which remains a constant menace to the patient.

Seel (*Zeit Urol Chir* 1931 33 282) reported three cases in which a diagnosis of renal tuberculosis had been made forty, twenty-eight and nine years respectively before being admitted to the clinic of Prof. von Lichtenberg. At operation advanced tuberculous changes (putty kidney) were found in all of the three cases. Young (*Jour Amer Med Ass'n* 1935 104 717) reports a case in which tubercle bacilli had been found in the ureteral urine seven years before the kidney was removed. The lesion was still relatively small at the time of operation.

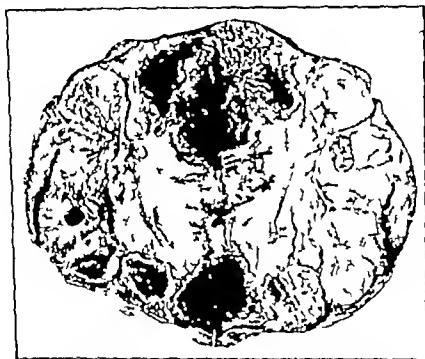


FIG. 515.—Specimen of advanced tuberculous pyonephrosis. Note almost complete replacement of parenchyma by ca. foci containing caseous material.

Wildbolz was able to follow 316 nonoperated cases of which 58 per cent died within five years after the diagnosis had been made and only 6 per cent lived more than ten years. The conclusions reached by Wildbolz (*Zeit. Urol Chir* 1932 42 257) are the following: 1. That recent observations do not justify any change in our present viewpoint that every patient with renal tuberculosis should be operated upon. 2. Only two cases have ever been reported of nonoperative healing of the caseous form. 3. The noncaseating forms appear to offer better prospects of spontaneous healing but cannot be distinguished in the majority of cases from the caseous form. The existence of the triad: bacilluria, pyuria and loss of function when unilateral may be considered as in all likelihood due to the caseous form and call for nephrectomy when the opposite kidney is normal. 4. In the presence of a unilateral bacilluria accompanied by a few leukocytes and no loss of function one is justified in assuming the existence of a noncaseating tuberculosis and that nonoperative treatment is justified provided that he or she is followed by a urologist. As soon however as there is a marked increase in the number of

leukocytes and noteworthy loss of function, as well as urographic evidence of even a small cavity formation, nephrectomy is indicated

OPERATIVE TREATMENT OF NEPHRECTOMY

The percentage of permanent recoveries is 80-90 per cent in early cases and 55-60 per cent for cases in all stages of tuberculous involvement of the kidney, if the disease is confined to one kidney

The immediate mortality following nephrectomy is from 3-5 per cent. Before removal of a tuberculous kidney is undertaken, the following potential sources of postoperative complications must have been excluded by a thorough preoperative examination

- 1 A poorly functioning kidney on the opposite side
- 2 Advanced tuberculous disease of the male genitalia
- 3 Advanced pulmonary or other extra-urogenital lesions

As to the first of these, the opposite kidney is often the seat of a toxic nephritis (albumin, casts, etc.) which disappears as soon as the tuberculous organ is removed. Wildbolz (1934) has found that the second of these complications, coincident genital lesions, plays an important part in the end results. The late mortality was 6.6 per cent when no coincident genital tuberculosis existed as compared to 27 per cent when it did. Complete recovery took place in 86 per cent of the cases when no coincident genital tuberculosis existed and in only 43.2 per cent when it did.

The contraindications to nephrectomy are nephritis or hydronephrosis in the opposite kidney, or any other condition which might lead to postoperative uremia. The presence of a calculus in the opposite kidney must always be excluded before a nephrectomy for renal tuberculosis is contemplated. Up to 1935, we found reports of five cases in which a calculous anuria presented at intervals of from 26 days to one year after nephrectomy for renal tuberculosis. In Groendahl's case, radiography failed to reveal any shadow on the opposite side. In the four others, no mention is made of such a preoperative examination but it is evident, as stated in the section on radiography and urography as diagnostic methods, that the possible existence of a calculus on the opposite side should always be kept in mind, hence the necessity of a plain film as a part of the routine examination of every case of renal tuberculosis is indispensable.

POSTOPERATIVE COMPLICATIONS

These can be divided into immediate and late

1 Immediate Postoperative Complications In addition to those incident to any kidney operation as discussed in Chapter 53, they are death from pulmonary, meningeal, adrenal and generalized miliary tuberculosis. Egon Wildbolz (Zeit. Urol. Chir. 1934, 39, 72) reported two fatal cases immediately after nephrectomy, due to tuberculosis of the adrenals. In the first case, a sudden rise of temperature and pulse rate about 36 hours after operation was followed by symptoms of collapse and death in a few hours. In the second case, the same syndrome appeared within the first 24 hours after operation and followed an even more rapid course. At necropsy, in both cases, an advanced bilateral tuberculosis of the adrenals was found. Clairmont reported a similar case due to adrenal insufficiency.

in 1932 (Schw Med. W 1932, No 39) No symptoms suggestive of Addison's disease were present before operation in these three cases

2 Later Postoperative Complications. These include a number of conditions most of which will only be enumerated

(a) Tuberculous infection of the bed from which the kidney was removed and of the parietal incision

(b) Fistula formation from upper end of ureteral stump

(c) Development of a tuberculous pyo-ureter with persistent pyuria.

(d) Signs of tuberculous in opposite (remaining) kidney

(e) Postoperative cystitis

Only the last of these later complications will be taken up here

Postoperative Cystitis. Persistence of bladder symptoms after operation may be due to empyema of the ureteral stump involvement of the remaining kidney or to extensive ulceration of the bladder mucosa. As a rule unless one of these sources of persistence of the tuberculous cystitis is present the majority of symptoms cease during the first six months after operation with concomitant disappearance of the pyuria and of the tubercle bacilli. That this is not always true was shown by one of us (Brit Jour Urol 1934 6 39). In five cases the cultures of the bladder urine were positive for tubercle bacilli three four five six and ten years respectively after nephrectomy. If reinfection of the bladder is not due to an empyema of the ureteral stump or involvement of the second (remaining) kidney the patient should be given the benefits of heliotherapy and sanatorium treatment as the first step in building up resistance. Bladder irrigations should be avoided because the forcible distension of the contracted bladder is very painful. Only instillations of 5-10 cc. of a 5-10 per cent solution of Gomenol or Gulacol are indicated. Others which can be employed injected through a Guyon instillator are 2 per cent solution of colloidal silver preparations especially Protargol or 1-2 per cent methylene blue solution. Fulguration for the ulcers is employed by some but it is questionable whether it is of much value. For the pain especially when tenesmus is complained of only opium and belladonna suppositories are of any avail.

BILATERAL CASES OF RENAL TUBERCULOSIS

Nephrectomy is only indicated if one kidney is the source of high temperatures and there is evidence of retention of pus.

CHAPTER 42

NEPHROLITHIASIS

INCIDENCE	EXAMINATION
PHYSICAL CHARACTERISTICS	GENERAL EXAMINATION
COMMON TYPES	UROLOGIC EXAMINATION
RARE TYPES	TREATMENT
CHEMICAL CHARACTERISTICS	PAIN
ANALYSIS OF RENAL CALCULI	ACUTE PYELONEPHRITIS SYNDROME
SITE	CALCULOUS ANURIA
COMPLICATIONS OF NEPHROLITHIASIS	PATIENT SEEN DURING A QUIESCENT PERIOD
INTRARENAL COMPLICATIONS	NONOPERATIVE TREATMENT
SPONTANEOUS RUPTURE	INDICATIONS FOR OPERATIVE INTERVENTION
SYMPTOMS	RECURRENT AFTER OPERATION
CLINICAL PICTURES	FALSE RECURRENCE
DIAGNOSIS	TRUE RECURRENCE
PATIENT'S HISTORY	

Mechanism of formation The various theories of the formation of urinary calculi were discussed in Chapter 26 and will not be repeated here

INCIDENCE

Case Incidence An interesting study of these aspects of urinary calculus in general has been made by Mr Hugh Lett (Brit Jour Urol 1936, 8, 205) Of 279,569 patients admitted to the surgical wards of the London Hospital from 1905 to 1934, there were 2781 (1 per cent) cases of calculus of the urinary tract In addition to these 2781 cases, 602 observed at the St Peter's Hospital (London) are classified as to which part of the urinary tract was the seat of the calculus Of the total number, 3383 cases, the calculi were located in the kidney in 1733 cases (over 50 per cent), in the ureter in 564 (about 16 per cent), in the bladder in 979 (about 31 per cent), and in the urethra in 107 (about 3 per cent) There were also 34 cases of prostatic calculi

The sex incidence varied in the 2781 London Hospital cases according to the location of the calculus, as follows: kidney, 849 males to 719 females, i.e. about equal, ureter, 335 males and 179 females, or two males to one female, bladder, 558 males and 50 females, or eleven males to one female Urinary lithiasis in general and especially nephrolithiasis occurs at any age It was formerly considered to be rare in infancy and childhood but, as will be shown in Chapter 46, this is not the case

PHYSICAL CHARACTERISTICS

Urinary calculi in general and especially those found in the kidney, vary in composition, size, shape and color as follows

COMMON TYPES

1 Uric Acid and Urate Calculi Pure uric acid calculi are rarely found in the kidney, the most common form being a sodium, ammonium or potassium urate calculus The latter are moderately hard and laminated on section Their color varies from yellow to reddish brown They are amongst the least radiopaque of all renal calculi (Fig 516)

2. Oxalate Calculi As a rule they are composed of calcium oxalate and may be associated with any of the other components of renal calculi although often found in pure form. They are very hard, dark brown to black in color, rarely larger than a hazelnut and have a rough surface. They are markedly radiopaque (Fig 516).

3. Phosphatic Calculi These are either composed of calcium and magnesium alone or of these two and ammonium phosphate, the so-called triple phosphate calculi. They usually occur in alkaline urine but may form in an acid medium. Their relation to infection by urea-splitting bacteria has already been referred to in Chapter 4 on the etiology of urinary calculi. These salts (calcium magnesium and ammonium phosphate) often form a coating around an oxalate or urate calculus acting as a nucleus. The phosphatic calculi vary greatly in size, hardness and color. When pure they are small, round, greyish white with a rough surface. Usually they are not very hard but friable because of the predominance of colloids in their formation. Phosphatic calculi rank third in the scale of radiopacity of renal calculi (Fig 516).

4. Calcium Carbonate Calculi These are rarely found in pure form, being as a rule associated in the formation of a calculus with one or more of the preceding components. When pure they resemble ordinary chalk in appearance and consistency, ranking first in the scale of radiopacity (Fig 516).

Order of Density of Calculus Shadows

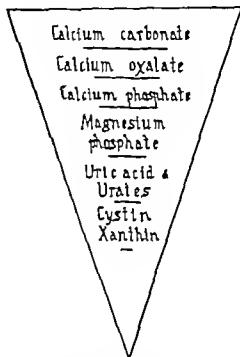


FIG. 516—Diagram to show the principal groups of urinary calculi arranged according to the density of the shadow which they give rise to radiographically (see text). Calcium carbonate gives the most intense, while pure cystin and xanthin calculi give the faintest shadow.

RARE TYPES

1. Cystin Calculi These are formed as the result of faulty metabolism of the amino acids. Up to 1936 about 200 cases had been reported. Cystinuria is both a hereditary and familial disease. Two articles have been recently published in each of which cystinuria was observed in two sisters.

THE SIZE AND FORM of the calculi vary greatly. Szold (Zeit Urol Chir 1936 41:195) reported a case in which there were multiple cystin calculi, some branched, some faceted with a phosphatic nucleus. Usually, however, the cystin calculi are small, oval or round, smooth and of a yellowish or greenish brown color. As to their location in the urinary tract, they do not differ from that of the commoner forms of calculi just discussed. There is some difference of opinion as to their radiopacity. Kretschmer, Pollak and others maintain that they are as radiopaque as the calculi of medium or intense radiopacity, while others have reported them as being very low down in the scale (Fig 516).

Cystin may be the only component or there may be varying degrees of phos-

phates and if the latter are present, usually some carbonate be found Cystinuria may occur without any evidence of the formation of cystin calculi This will be taken up later under Diagnosis

2 **Xanthin Calculi** These are very rare Kretschmer (Jour Urol , 1937, 38, 183) could only find 15 cases, 68.7 per cent of which were pure, and 31.2 per cent combined with the more common components of renal calculi Positive X-ray evidence was found in three cases Xanthin calculi are brown to reddish in color, hard and laminated They present no distinctive clinical features

3 **Bacterial Calculi** These show a laminated structure and are made up of bacteria, usually *B. coli* They vary in size from a pinhead to a cherry, are greyish in color, smooth and of elastic consistency Very few cases of this type of calculus have been reported

4 **Fibrin Calculi** They are composed of old hematoma in which crystalline or amorphous deposit has taken place Ikoma (Zeit Urol Chir , 1924, 15, 1) could only find 19 reported cases

CHEMICAL CHARACTERISTICS

ANALYSIS OF RENAL CALCULI

This aspect of nephrolithiasis has assumed considerable importance in view of the present efforts to diminish the incidence of recurrences after operation Randall, Campbell and Beeson in reporting (Urol and Cut Rev , 1934, 38, 29) the results of the analysis of 117 cases of urinary lithiasis state that the Hammersten technic as modified by J. S. P. Beck is the simplest method of qualitative analysis, the amount of calculus necessary for a complete analysis rarely exceeding 60 mg and the time required, fifteen minutes

TECHNIC

Calculus has been cleaned, dried and pulverized Heat a portion of the powder on a platinum foil

- A If powder does not burn it is inorganic material
 - a Add concentrated hydrochloric acid
 - 1 If effervescence—**Calcium Carbonate**
 - 2 No effervescence—proceed to b
 - b Heat a portion of the original powder gently in an evaporating dish and add HCl (concentrate)
 - 1 If effervescence—**Calcium Oxalate**
 - 2 No effervescence—proceed to c
 - c. Treat a portion of the original powder with 10 per cent potassium hydroxide
 - 1 Ammonia odor evolved, powder is soluble in acetic acid and a crystalline precipitate forms on addition of ammonia water—**Triple Phosphates**
 - 2 If no ammonia odor evolves, or only traces, and the powder dissolves in acetic acid of concentrated HCl, add concentrated ammonia—**amorphous precipitate—Calcium and Magnesium Phosphates**

May check crystalline triple phosphates and amorphous Ca and Mg phosphates by microscopic examination

- B If powder burns it is organic material

- a If burns with flame

- 1 Flame yellow and continuous Odor of burning feathers Insoluble in

alcohol or ether Soluble in warm 10 per cent potassium hydroxide. Precipitated by acetic acid with evolution of hydrogen sulphide gas—Fibrin.

2 Flame pale yellow and continuous Odor of resin Soluble in alcohol or ether Absorbs fat stains—Urostealth.

3 Flame pale blue and brief Peculiar sharp odor Soluble in NH_4OH with separation of six-sided plates on evaporation—Cystin.

b Without flame To powder

1 Apply the Murexide Test Moisten the original powder with a few drops of strong nitric acid. Evaporate this to dryness in an evaporating dish at a temperature not exceeding 110 degrees Fahrenheit A yellowish or brownish mass remains. To this add a drop of concentrated ammonia. A purple color appears. Add a drop of 10 per cent sodium hydroxide solution. If a violet color appears the test is positive The powder contains a metallic urate which is probably Sodium Urate.

2 If ammonia odor evolves on the addition of 10 per cent sodium hydroxide—Ammonium Urate

3 If no ammonia or little ammonia evolves on the addition of 10 per cent sodium hydroxide—Uric Acid.

4 If the dry yellow mass becomes orange with the addition of 10 per cent sodium hydroxide and then red on gentle warming—Xanthin.

If the calculus is sufficiently large wrap it in a piece of paper and saw it into halves Peel off each layer separately and reduce each to a fine powder Examine each layer separately and try to determine the component of each layer and the nucleus.

SITE

A preliminary knowledge of where renal calculi are located is of great aid in understanding the pathology, interpretation of plain films clinical pictures and operative treatment. We will enumerate them in the order of their frequency

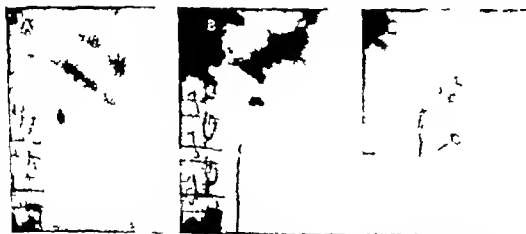


FIG. 517—Three radiographs from case of renal calculus in which migration occurred.

A. Calculus blocking outlet of renal pelvis.

B. Calculus has slipped back into pelvis proper

C. Pyelogram showing calculus in inferior major calyx (location indicated by arrow)

1 At the Outlet of the Renal Pelvis (Fig 517) The form most commonly found is round or triangular but a portion of a branching calculus (Fig 530) may equally as well project into the outlet of the renal pelvis

2 In a single major or minor calyx, with (Fig 518) or without projections into the pelvis proper These are often round or oval (Fig 519) Calculi lying in

a calyx whose neck has been obliterated by cicatricial changes, are termed "encysted" (see Fig 520)

3 The so-termed coral or branching calculus which forms a more or less cast of the renal pelvis and its calices (Fig 523) Such a calculus may not show any interruption in continuity or there may be multiple small calculi in the calices which are in contact with the main portion (A of Fig 521)

4 Multiple relatively large calculi (B of Fig 521) which show facets where they come in contact with each other

5 Calculi in the Parenchyma This location is very rare but a typical example has been reported by McKechnie and Priestley (Bull

FIG 519



FIG 518



FIG 518—Shadow of branching urate calculus filling lower major calyx of kidney The only symptom was hematuria

FIG 519—Shadows of two laminated renal calculi, one in renal pelvis and the other in a calyx at lower pole of kidney

Mayo Clinic, 1937, Jan 13, page 21), which was only found at examination of the kidney after removal

6 Bilateral Calculi These occur in about 20 per cent of all cases Any of the above combinations can be found, such as a pelvic calculus on one side and one in the calyx (Fig 531) in the opposite kidney, multiple single on one side and a branching calculus on the other, multiple small on both sides or bilateral branching calculi

Coincidence of Renal, Ureteral, Vesical and Urethral Calculi In many cases lithiasis is not limited to one or both kidneys but the latter are associated with calculi in other parts of the urinary tract Here again a number of possible combinations are found Of especial importance from the standpoint of treatment are coincident calculus formation in the kidneys and ureters, hence these will be

discussed later under Treatment of Bilateral Renal and Coincident Renal and Ureteral Lithiasis.

COMPLICATIONS OF NEPHROLITHIASIS

INTRARENAL COMPLICATIONS

Replacement Lipomatosis. Although this may occur in any form of chronic renal infection it is a sequel of infected nephrolithiasis in 79 per cent of the cases in which it is found according to Young (*Jour Urol*, 1933 29 631) It may be found both in calculous hydronephrosis (Fig 462) and pyonephrosis (Fig 523)

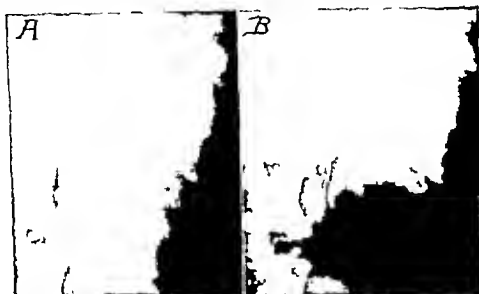


FIG 520—Two films from case of encysted calculi of left kidney. In A, the shadows are seen located relatively far from spine. In B they are shown lying in minor calices at lower pole of the kidney but none of the opaque medium employed in making the program enters the calices in which the calculi were found. A similar case is shown in Fig. 530.

Among the 33 cases collected by Kutzmann only five were without calculi. In one of the cases reported by Young neither infection nor calculus formation was present but this is rare. According to Lieberthal (*Surg Gynec. and Obst.* 1935 61 794) the underlying cause is chronic infection. Marked increase in fibrous tissue may change the fat into a fibrosclerotic mass and occasionally calcification or a metaplasia to hyaline cartilage or even bone formation is observed. The sclerosis may involve the capsule and extend along the pedicle so that isolation of the vessels is rendered very difficult (see Chap 53). In one of our cases the kidney was represented by a mass of fat divided by septa surrounding a calculus in the pelvis.

Coincident Nephrolithiasis and Tuberculosis. One of us has recently (*Surg Gynec. and Obst.* 1935 60 77) reviewed this complication and analyzed 40 cases (including five personally observed) reported since 1920. True calculus formation occurs in about 1.8 per cent of all cases of renal tuberculosis. One must distinguish between calcification (Fig 509) as found in about seven per cent of all cases of renal tuberculosis and true calculus formation in a tuberculous kidney. The 40 cases could be divided into four groups:

- (a) Calculus and tuberculosis on the same side (26 of the 40)

- (b) Tuberculosis on one side, calculus in the opposite kidney (5 cases),
- (c) Bilateral renal or ureteral calculi and unilateral tuberculosis (4 cases),
- (d) Bilateral renal tuberculosis and lithiasis (4 cases of little clinical interest)

Lieberthal (Urol and Cut Rev, 1936, 40, 636) added two clinical and one necropsy observation

Coincident Neoplasm and Nephrolithiasis In a recent review of the literature, Polkey (Urol and Cut Rev, 1936, 40, 867) found 200 cases of this association, including a personal observation. In a total of 2469 cases of nephrolithiasis, neoplasm was found in 0.45 per cent. Sarcoma of the kidney associated with renal calculus is much more rare than the epithelial types of neoplasms and hypernephroma. Kretschmer (Jour Urol, 1936, 36, 99) could only find five reports of sarcoma and renal calculus, to which he added a personal case of spindle-cell sarcoma in a patient who had a multiple renal calculus. In one of our cases a papillary carcinoma of the renal pelvis was found associated with nephrolithiasis.

SPONTANEOUS RUPTURE

Expulsion of Calculus into Perirenal Tissues In certain cases of in-

FIG 521



FIG 521—A Shadows of a large calculus filling renal pelvis and several smaller ones in the calices
B Multiple large calculus shadows showing facets

FIG 522

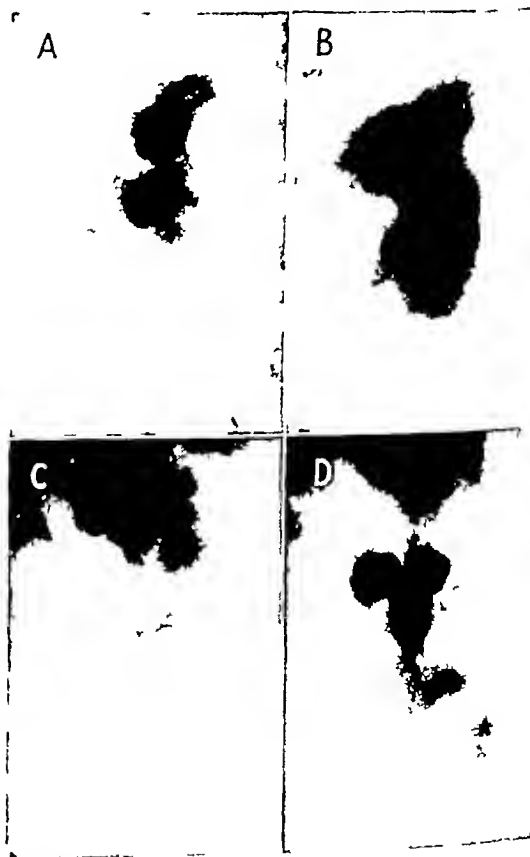


FIG 522—Four large branching (coral) calculus shadows

fectured nephrolithiasis, a calculus escapes into the fat surrounding the kidney, where it may give rise to a perinephritic abscess or to urinary infiltration. In one of our cases, the renal pelvis was blocked by a triangular calculus and there was also a stricture of the ureter at the ureteropelvic junction. At operation (Fig 524) a calculus was found on the surface of the kidney. In another case there was a perinephritic extravasation of urine due to rupture of a calculus pyonephrosis.

Fistula Formation As a sequel of rupture into the fatty capsule of the kidney, can be mentioned such cases as those reported by various authors in which fistulae were found in the lumbar, inguinal or thigh regions as well as those in

which there existed a fistulous communication between the kidney and the colon. In Ravich and Katzen's case the diagnosis was made by injecting the fistula in the

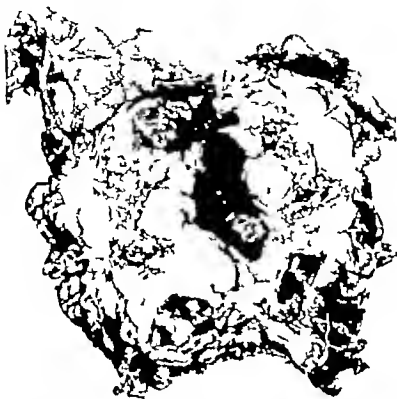


FIG. 523.—Branching calculus in renal pelvis associated with advanced replacement lipomatosis. Only a rim of parenchyma is to be seen at upper pole and a few dilated calices at the lower pole.

inguinal region and following the opaque medium to the calculous pyonephrosis. Vermooten and McKeown found nephrolithiasis in one third of 34 cases of renocolic fistulae. In all but two (where it communicated with the pelvis) the tract led to a calyx. In this same group belongs the case reported by Jones and Hughes (*Jour Urol.* 1934 32 242) and by Crenshaw (*Jour Urol.*, 1933 28 428) in which a calculous pyonephrosis communicated with a bronchus.



FIG. 524.—Two views of a kidney removed because of spontaneous perforation (left hand illustration) of calculus, and a large calculus completely blocking pelvic outlet. Note stricture area just below ureteropelvic junction. There were also several other calculi and evidences of chronic pyelonephritis.

Generalized Peritonitis. In all of the reported cases there was a communication between a calculous pyonephrosis and the peritoneal cavity. James (*Brit Jour Urol.*, 1933 5 386) reported such a case and was able to find three others (Hammel Rost Michel) Fuss (*Munch Med Woch* 1934 2 1575) added a fifth Couvelaire (*Bull Soc Chir Paris* 61, 760) in reporting a case stated that 11 others had been reported.

Perforation of Main Renal Artery or Vein. In a recent article Widrich (*Zeit Urol Chir.*, 1933 38 210) states that Schede observed a case of fatal hem

orrhage In two other reported cases, an aneurysm formed as the result of perforation of the main renal vein by a calculus In the first, a severe hematuria necessitated immediate operation At the latter, a large perinephric hematoma was found The source of the bleeding was a perforation of a large renal vein (prepelvic) by a calculus In the second case, the clinical history of severe hematuria and the operative findings were similar In both cases nephrectomy was done

SYMPTOMS

CLINICAL PICTURES

No single or group of symptoms are pathognomonic of renal calculus They are all to be found in the history of a number of other affections of the upper urinary tract In taking the history of a suspected case of renal calculus, it is convenient, however, to remember that this condition presents clinically (Fig 525)

FIG 525

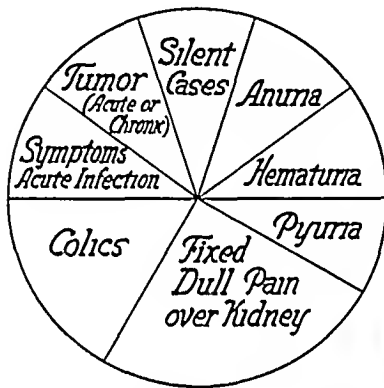


FIG 526

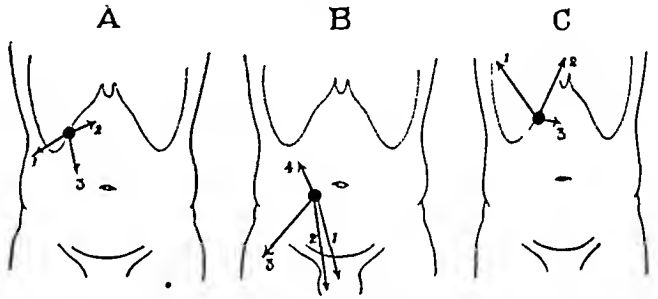


FIG 525—Diagram to illustrate the various clinical pictures presented by renal calculi
FIG 526—Radiation of pain in renal, ureteral and biliary calculi

A In renal calculi, most frequent direction (1) is backwards (toward ilio-costal space), next toward front of abdomen and mesially as shown by 2, least common downwards along ureter (3)
B In ureteral calculi most frequently (1) downwards along course of ureter, less typically to corresponding testis (2), thigh (3) and upwards toward kidney (4)
C In biliary calculi most common direction of pain radiation (1) is toward right shoulder, less often to left shoulder (2) or midline of abdomen (3)

under a number of pictures in which there is a single outstanding feature which may or may not be associated with those of other clinical pictures

1 Pain is the chief complaint

This is the most typical of all of the symptoms of nephrolithiasis It may be

OF AN INTERMITTENT (COLICKY) CHARACTER This is the more common type The pain is very severe and usually accompanied by reflex symptoms, such as nausea and vomiting, profuse perspiration and more or less abdominal distention, due to reflex paresis of the intestinal musculature

The pain most often in the case of renal calculi (A of Fig 526) radiates backward, less often inwards and least often toward the umbilicus If the calculus leaves the renal pelvis and enters the ureter, the radiation of pain is as was described under ureteral calculi (see B of Fig 526) The pain in acute cholecystitis most often radiates to the right shoulder, less often inwards or downwards (C of Fig 526)

FIXED PAIN This is never as severe as the colicky type just described It is

referred to the iliocostal space or the upper abdominal quadrant of the side upon which the kidney is located

2 Symptoms of Acute Pyelonephritis Dominate the Clinical Picture

The onset is sudden with a chill high temperature rapid pulse, accompanied by local evidences in the form of muscular rigidity and tenderness over the upper abdominal quadrant or iliocostal space. In some cases there is a history of colicky pain preceding the above symptoms or the patient complains when first seen of severe fixed or radiating pain over the kidney. In others and this must not be overlooked there is an absence of a history of pain or similar attacks and no complaint of pain during the present attack. The pathological condition which gives rise to this clinical picture of acute pyelonephritis is a sudden occlusion by a calculus of the ureteropelvic junction (Fig 539). The symptoms may recede as suddenly as they appeared if the calculus ceases to block this outlet of the renal pelvis.

3. Symptoms of Chronic Pyelonephritis Dominate the Clinical Picture

Many patients consult a physician because of a persistent pyuria with or without the other symptoms described as being found in chronic pyelonephritis (see Chapter 39). During the search for the source of a pyuria or other evidences of a chronic renal infection, a nephrolithiasis is often discovered.

4 A Microscopic or Gross Hematuria Is the Principal Complaint

Although microscopic hematuria is a frequent finding a gross hematuria is not frequently observed in nephrolithiasis as in other renal affections such as neoplasms.

If there is a history of attacks of colicky pain or of recurrent acute febrile attacks, the symptom hematuria either gross or microscopic, may be important in the evaluation of the clinical history as indicating the probable existence of nephrolithiasis.

5 Anuria Predominates the Clinical Picture (See also Chapter 47)

The sudden or gradual onset of anuria is not a characteristic symptom of nephrolithiasis but it is important in taking a history to ascertain whether there have been any attacks which either receded spontaneously or after treatment. In calculous anuria the latter may be the only symptom. In many cases the attack was preceded by a colicky or fixed pain or there is a history of them in the past history.

The symptoms in a case of calculous anuria vary according to its duration. Following the onset i.e. from the time the anuria is discovered there is a period of tolerance which varies in duration from 24 hours to twenty nine days in the longest recorded case. During this period of tolerance the patient may appear in perfect health except that no urine is being voided and none is found in the bladder on catheterization. In another group of cases there may be slight indications of impending trouble in the form of headache nausea or even vomiting muscular twitchings and hiccup. This syndrome corresponds to a mild degree of uremia.

In both groups of anuria cases whether there has been an absence of symptoms or those appear which have just been described the period of tolerance is followed by the clinical picture or syndrome of uremia in the form of generalized convulsions lethargy followed by coma and death.

DIAGNOSIS

This is based upon an evaluation of the patient's history and the results of his or her examination

THE PATIENT'S HISTORY

Family History Cystin nephrolithiasis has been found to be hereditary and also to occur in members of the same family, e.g., sisters. Hence, it is of importance to ascertain whether cystin calculi have ever been found in making inquiries as to any hereditary or familial diseases.

Previous History If the illness for which the patient consults a physician or enters a hospital presents one of the clinical pictures described under Symptoms, it is desirable to ask if one of the following has ever been observed prior to the present illness.

(a) A single or recurrent attack of severe colicky or fixed pain referred to the kidney region and radiating as described above (Fig. 526)

(b) Acute febrile attacks with or without preceding or concomitant pain

(c) The sudden appearance of anuria which receded spontaneously or after treatment

(d) The persistence of pyuria with or without accompanying pain, fever, and other symptoms of chronic pyelonephritis

(e) The persistence of microscopic hematuria or the history of one or more attacks of symptomless gross hematuria

(f) The history of the passage of calculi or of crystals (or uric acid or oxalate of calcium) in "showers" accompanied by colicky pain

In looking over this list of clinical pictures in which there is an outstanding symptom such as pain, febrile attacks, etc., it will be seen that all, with the exception of the last named, occur in other affections not only of the kidney but of the ureter as well. Hence, before any value can be placed upon such salient features in the previous history, they must be interpreted for diagnostic purposes, in the light of the results of the examination of the patient. One clinical feature of nephrolithiasis must be constantly borne in mind in taking the history, and that is, the occurrence of latent cases. The family and previous history reveal no data which point to any kidney condition, yet when search is made for the source of a pyuria or during routine examination for other abdominal conditions, a nephrolithiasis is found.

BONE LESIONS Question must also be directed in taking a patient's history to learn whether any spontaneous fractures have occurred. We know that this takes place in cases of hyperparathyroidism, which in turn plays a role in the etiology of renal calculi.

That a certain relation exists between calculus formation and certain bone lesions can no longer be denied. Hence, in checking over the previous history, the occurrence of fractures of the spine, chronic osteomyelitis and long confinement in bed for orthopedic conditions should be kept in mind as etiological factors. This is also true as to oxaluria, phosphaturia and uric aciduria of long duration.

EXAMINATION

This must of course vary according to the condition or clinical picture existing at the time the examination is made. To attempt to apply all of the

various diagnostic methods to cases of nephrolithiasis during an attack of colicky pain of high temperature of anuria or of hematuria would it is self-evident be poor judgment. We will therefore take it for granted that the clinical picture is that of the quiescent stage in advising the use of the following diagnostic methods.

GENERAL EXAMINATION OF THE PATIENT

This should include especially a flat plate of the lungs for evidences of tuberculosis palpation of the abdomen for enlarged kidney and search for any external signs of an anomaly which might favor stagnation.

UROLOGIC EXAMINATION

Plain radiography supplemented by urography. With the present-day perfection of radiographic technic it is possible to obtain positive evidence (shad-



FIG. 52.—Visualization by retrograde urography of nonopaque renal calculi (see text).
A A filling defect due to calculus in pelvis when only 2-3 cc. of opaque medium are injected.
B A second case with filling defect. (Kindly loaned by Drs. Bachrach and Segalitz of Vienna.)

ows) of renal calculi in 90 per cent of all cases; hence the calculi can be placed in two groups as follows: radiopaque, nonopaque.

Radiopacity of Renal Calculi. Clinically very few pure calculi, i.e. composed of crystals of a single urinary salt, are encountered. With the exception of uric acid, many urate, most cystine and all xanthine calculi, all calculi are made up of different crystalline components whose chemical composition varies according to the individual salt. Hence we speak of radiopacity; it is that of the calculus as a whole, the intensity of the shadow depending upon the predominance of one of its constituents. The order of radiopacity from the highest to the lowest degree of opacity is shown in Fig. 516, but it is necessary to state that according to a recent publication (Kretschmer) the radiopacity of cystine calculi ranks after those of

important part of the diagnosis. Errors in the interpretation of shadows in the kidney region are rare at the present time as compared to the period before the use of the opaque ureteral catheter, urography and cholecystography were known.



FIG 532—A shadow over the right kidney area was at first thought to be due to a biliary calculus. Cholecystography showed that this was not the case. A. In order to determine its location, a urologic study was made. This revealed the fact that an opaque ureteral catheter completely encircled the shadow, B, and that the shadow was included in a pyelogram, C. Pyelotomy was done and a round calculus was removed from a pelvis in which migration had taken place from the renal pelvis to a calyx and vice versa.



FIG 533—Shadows of biliary calculi.
 A Round shadow with dark center and light periphery so often seen in biliary calculi.
 B Opposite relation of center and periphery.
 C Similar relation of varying density of shadow in a calculus (biliary) in a case of hepatoptosis.
 D Calculus in common duct. (Courtesy of Drs. Arens and Friend.)

THE PRINCIPAL CAUSES OF ERROR are shadows due to the following extrarenal conditions:

Areas of calcification in the renal vein (Stirling) and artery (Fish and Hallock)

Calcified retroperitoneal lymph nodes

Biliary calculi

Pancreatic calculi (very rare)

OTHER CAUSES OF ERROR In addition to the above intrarenal shadows one must keep in mind the existence of calcification either independently or associated with true calculus formation in renal tuberculosis (Chap 41) and also that calcification has been noted in hypernephromata and in replacement lipomatosis



FIG. 534—Combined biliary and renal calculus shadows. Shadow of a branching renal calculus is seen close to tip of right transverse process of third lumbar vertebra. A little lower multiple shadows of biliary calculi in a posed gallbladder are visible. (Cook County Hospital case)

CALCIFIED RETROPERITONEAL LYMPH NODES do not offer as a rule any difficulty in their interpretation. The shadow varies in intensity i.e. it is not uniformly of the same density as in the case of renal or ureteral calculi and also the form (Fig 509) is irregular and the borders are notched. When the calcified nodes are oval and they are grouped as in Fig 384 the diagnosis without the aid of the opaque ureteral catheter and urography is not so simple.

THE SHADOWS OF BILIARY CALCULI may greatly resemble those of renal calculi (Fig 532). When only a single biliary calculus is present the differentiation is more difficult than when multiple small shadows of biliary calculi are present (Fig 534). The shadow of a biliary calculus is seldom of uniform density. Either the center is dark and the periphery lighter or vice versa (Fig 533). It must be remembered that renal and biliary calculi may be coincident (Fig 534). In an

article (Surg Gyn and Obst 1929, 49, 1) one of us has called attention to the value of combined urography and cholecystography in cases where there is a question as to whether the shadow is that of a renal or biliary calculus (Figs 532 and 535)

Urography is of great aid in solving the problem of why the shadow of a renal calculus is found in the kidney region and at the lower end of the ureter in successive films. We have seen several of such cases, which could only be understood when the urogram revealed (Fig 536) an advanced degree of ureter



FIG 535 —Differential diagnosis between biliary and renal calculi. Note relation of urogram to multiple faceted shadows of calculi in gallbladder

ectasis and pyelectasia which permitted the calculus to migrate from the renal pelvis to the pelvic ureter and vice versa

Cystoscopy and ureteral catheterization

Cystoscopy and ureteral catheterization enables the urologist to gather information

1 AS TO THE LOCATION OF AN OBSTRUCTION i e , whether it exists distal to the renal pelvis which favors stasis and infection, these in turn being followed by calculus formation and recurrences after operation, unless the source of the stasis is eliminated or at least lessened as an etiologic factor

2 BY OBTAINING SPECIMENS OF URINE from the bladder and each kidney to secure information

AS TO THE TYPES OF BACTERIA with the aid of smears and cultures, especially the presence of urea-splitting organisms

THE PH OF THE URETERAL URINES

THE PRESENCE OF CRYSTALS CASTS AND NUMBER OF RED AND WHITE BLOOD CELLS TO THE HIGH POWER FIELD

3 ENABLES THE FUNCTIONAL CAPACITY OF EACH KIDNEY to be determined by the urologist before ascending urography is employed.

Blood Chemistry

This should include urea uric acid calcium phosphorus and sugar estimations Serum calcium above 11 mg per 100 cc and serum phosphorus below 3.5 mg per 100 cc. should arouse suspicion as to the possible presence of hyperparathyroidism. If the latter exists the serum calcium may vary from 11.5 to 16.8 mg



FIG. 536.—On the left is seen the shadow of a renal calculus which is included in pyelogram as shown at right. The enormous dilatation of the pelvis and ureter permitted the calculus to migrate, so that at operation it was found in juxtavesical portion of the ureter.

or even higher and the serum phosphorus may range from 1.4 to 4.7 mg according to Barney and Mintz (Brit. Jour Urol. 1936 8 36). While hyperparathyroidism is responsible for only 4.5 per cent of all cases of urinary calculi the incidence of the latter in hyperparathyroidism may be almost 70 per cent.

The diagnosis of cases in which the salient feature is pain, fever or anuria will be discussed in connection with their treatment.

TREATMENT

We will group the cases in accordance with the way they are met with clinically.

PAIN

Severe Pain the Outstanding Feature of the Clinical Picture. The pain is the result of sudden increase in the intrarenal tension caused by the blocking of the outlet of the renal pelvis by a calculus. This is more likely to occur if

the calculus is small, than when larger ones are in the renal pelvis. Some of these acute renal blocks are difficult to diagnose because of the coincident distension of the bowel by reflex action so that the clinical picture resembles that of other affections included under the term "acute abdomen." The first indication is to relieve the pain by opiates, preferably morphine hypodermically. If the patient can be brought to a hospital, a plain film should be taken and a ureteral catheter passed beyond the obstruction at the ureteropelvic junction. This procedure gives immediate relief as we have found in a number of cases. At times, 30-40 cc of urine under tension, will escape through the catheter. If it is impossible to pass beyond the obstruction, immediate pyelotomy for removal of the impacted calculus is indicated, followed by drainage by means of a nephrostomy. In the majority of cases an emergency operation is not needed because the obstructing calculus floats back into the pelvis or one of the calices.

ACUTE PYELONEPHRITIS SYNDROME

In this group, both an early diagnosis and treatment are necessary to save the life of the patient in many cases. Occasionally after 24-48 hours of forced fluids, rest in bed, opiates and urinary antiseptics, such as methenamine or sulfanilamide in relatively large doses, the fever and other evidences of acute urinary sepsis will recede because the occluding calculus (Fig 517) becomes dislodged and, as in the preceding group, comes to lie in another part of the pelvis or in one of the calices. If the chills, fever, marked leukocytosis and increasingly more serious general symptoms of bacteriemia persist for more than 48 hours, watchful expectancy must end and be replaced by more active treatment, lest not only the involved kidney be irreparably damaged, but a fatal generalized sepsis follow. If the infection has once extended beyond the kidney, even nephrectomy will not save the patient.

Our plan is to insert a ureteral catheter as soon as possible beyond the occluding calculus and after aspirating the contents of the renal pelvis for bacteriological examination, to leave the catheter in situ until the acute symptoms have disappeared. The case then belongs in Group 4a to be discussed further on.

A plain film should be exposed as soon as a patient with a calculous block and coincident symptoms of acute renal infection is seen. If there are no signs of recession of the fever, etc. after 48-72 hours of inlying ureteral catheter drainage, this means that the kidney parenchyma (Plate XI) is involved to such an extent, that immediate operation is necessary. If there are innumerable single or groups of pus foci after removing the capsule and the kidney is greatly enlarged, opinions differ as to whether such a kidney should be removed or only a nephrostomy done. If we have ascertained during the period in which the inlying ureteral catheter, by the employment of intravenous urography, that the patient has another good functioning kidney, we believe that more lives will be saved by nephrectomy in these hyperacute infections, than by resorting to decapsulation and nephrostomy.

CALCULOUS ANURIA

These also require early diagnosis and treatment and one should not be lulled into a false sense of security because as described in Chapter 47, the patient often presents absolutely no signs of impending disaster during the period of tolerance.

There may be a history of previous attacks of anuria which disappeared

spontaneously or following the passage of a ureteral catheter and expulsion of a calculus. On the other hand the present attack may be the first in a patient who not only fails to give a history indicating upper urinary tract lithiasis but also states that the existing anuria appeared suddenly without any preceding pain either colicky or fixed. Finally in a third group the patient states that severe pain was followed by a noticeable diminution in the amount of urine passed, i.e. oliguria and then complete inability to urinate supervened.

No time should be lost in having a plain film made to see where the calculus is located i.e. whether in the renal pelvis or ureter and on which side. Failure to obtain a positive result by plain radiography does not exhaust the diagnostic resources at our disposal. Intravenous urography should follow such a negative result to see if there is any obstruction in the renal pelvis or ureter. Even this may not yield any information unless the occlusion is so complete that none of the opaque medium passes alongside the calculus. It may happen that the obstructing calculus is of the nonopaque variety referred to under Diagnosis. We recall several cases and similar ones have been reported by Cahill in which plain radiography was negative in calculous anuria. The method which is most likely to succeed in not only confirming the suspected calculous origin of the anuria but also to determine the side and level of the obstruction is ureteral catheterization. This should be carried out as soon as the diagnosis of anuria has been made by finding the bladder either empty or only containing a few cc. of urine. The treatment of calculous anuria due to a renal calculus does not differ from that of anuria following impaction of a ureteral calculus which was considered in Chapter 31.

PATIENT SEEN DURING A QUIESCENT PERIOD

NONOPERATIVE TREATMENT

Medical Treatment Can Be Given a Trial Under Certain Conditions
In this group can be placed

- (a) Patients who refuse an operation
- (b) Patients with bilateral calculi who cannot be operated upon
- (c) Patients who constantly expel calculi but radiography is negative
- (d) Those who have recurrences following operation. This last subgroup will be discussed under postoperative management later.

MINERAL WATERS As to the first three subgroups several methods are available. One of these which is extensively employed in certain European countries consists essentially in having the patient follow a 3-4 weeks so-called cure at Vittel or Evian in France or Wildungen in Germany. In France it is simply a question of drinking large quantities of a water containing an infinitesimal amount of mineral ingredients the underlying idea being thoroughly to flush the kidneys. In Wildungen the water is distinctly alkaline and especially adapted to the treatment of patients with uric acid, urate or cystine calculi.

ACID-ASH DIET Recently C. C. Higgins (Surg. Clin. North Am. 1935, 15:923) has reported the successful solution of renal calculi by administration of an acid-ash diet supplemented by vitamins from various sources. This work was based on the earlier work of many investigators and also on his own animal experimentation. The objective of Higgins' dietary management is to bring the pH of the urine down to 4.9-5.2. In patients in whom an infection due to urea

splitting bacteria is present, acidifiers were also employed. The results in nine cases were as follows:

In three cases, complete disappearance of the calculi within four months.

In one case no change.

In a bilateral case with a large calculus on one side and five on the opposite one, all of the latter disappeared in seven weeks, but there was no change in the large one.

In two bilateral cases, a distinct diminution in the size of the shadows.

In one case, 300 calculi expelled soon after beginning the treatment.

In the ninth patient, a large calculus entirely disappeared.

Oppenheimer and Pollack (*Jour Amer Med Assn*, 1936, 108, 349) employed a diet which differed somewhat in detail but not in principle from that used by Higgins. When the pH of the urine could not be brought down to the desired level by diet alone, it was found that only in occasional cases did ammonium chloride up to 6 Gm daily succeed in changing the urinary pH. In addition to the diet, vitamins A, B, D, E and G were given. Twenty-seven patients were on the diet for from six to sixteen months. Twenty of these maintained a mean bladder urine pH of 5.2 or under. In none was a complete or partial solution (disappearance) of the urinary calculus noted on the frequently controlled x-ray films. Five patients showed an increase of their renal calculi and in one patient a new calculus formed while on the diet.

Lazarus and Rosenthal (*Urol and Cut Rev*, 1936, 40, 1) in six cases treated for over five months, found in only one evidence of partial solution, in four no change was noted, and in one, the calculus increased in size. In six other cases treated for less than five months, two showed enlargement and increase in number of the calculi and in the other four, no change was noted.

From the above reports, it is impossible at present to decide whether solution of calculi by the acid ash diet supplemented by various vitamins and acidifiers is feasible.

INDICATIONS FOR OPERATIVE INTERVENTION

A distinction must be made between the indications for operation in unilateral and those applicable to bilateral cases. The incidence of the latter varies from 10-15 per cent as shown in the recent reports of Illyes, 10 per cent of 842 cases, Priestley (Mayo Clinic), 14.8 per cent of 500 cases, Twinem, 13 per cent of 314 cases and White, 13.8 per cent of 1119 cases. We will first discuss the unilateral cases.

Indications for Operation in Unilateral Cases

1. If a calculus is so located in the renal pelvis as to be a potential menace to the integrity of the kidney or even to the patient's life, by its likelihood of blocking the outlet of the renal pelvis (Figs 517, 531 and 537).

2. If there is one relatively large but not branching calculus in the renal pelvis and one or more located independently in the calices and urography and function tests show that the damage to the kidney is still slight and that the infection which favored the calculus formation and all causes of stasis can be eliminated by postoperative treatment (see later).

3. Nephrectomy is indicated (a) if there is evidence of a calculous pyonephrosis (Figs 523 and 538) and the opposite kidney is normal, (b) in cases of

associated tuberculosis or neoplasm and true calculus formation (c) in cases in which recurrence has taken place two or three times after conservative operations

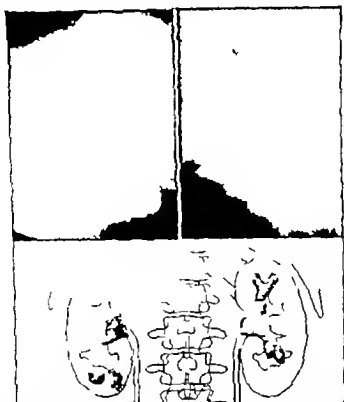


FIG. 537.—The upper illustrations show shadows in a bilateral renal calculus case. The lower diagrams show locations of calculi as found at operation. The right sided calculi were removed by ordinary pyelotomy and small nephrotomy incisions (see Chap. 56). The larger left sided branching calculus was removed through an enlarged pyelotomy incision (see Chap. 56).



FIG. 538.—Plain film of large branching calculus and operative specimen of same case, showing advanced destruction of the kidney parenchyma.

and attempts to control the infection or to eliminate a cause of stasis (Fig. 539) or infection (Fig. 540) have been futile.

AS TO THE TYPE OF OPERATION—if it is possible to perform a pyelotomy this is the method of choice, except for calculi located in the isthmus of a calyx, here nephrotomy is preferable to avoid injury to the isthmus and probable postoperative stricture formation. If a single calculus lies in a dilated infected calyx, it is

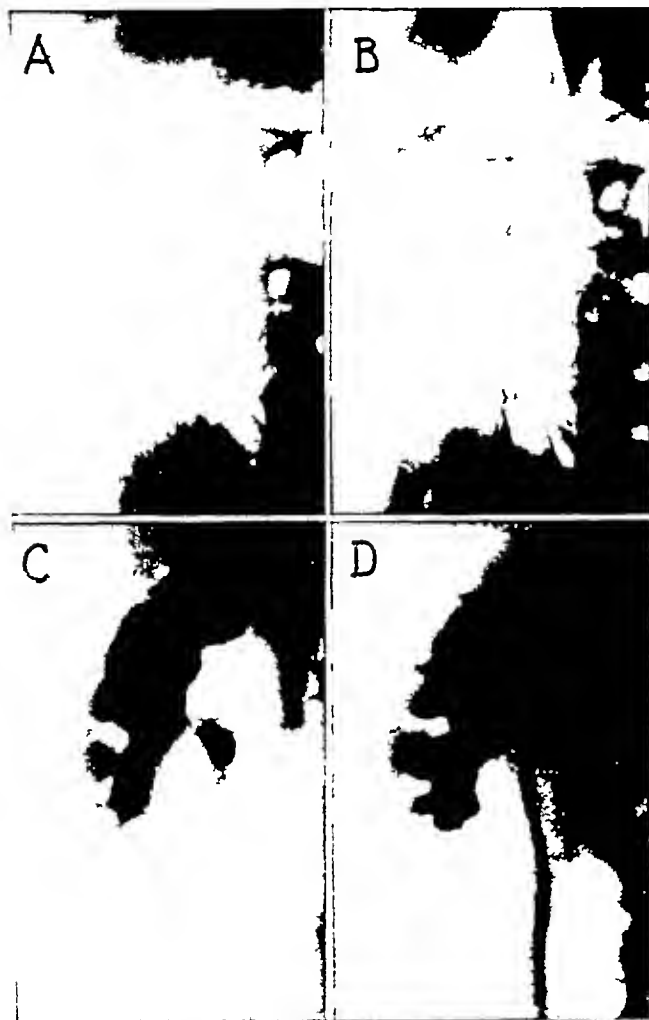


FIG 530—A series of pre- and postoperative illustrations to show how dilatation of calices and infection can persist after removal of calculus

- A Shadow of calculus at ureteropelvic junction
- B Relation of calculus shadow to rolled up tip of opaque catheter
- C Pyelogram showing marked dilatation of calices and pelvis
- D Same condition two months after pyelotomy for calculus

(d) in one kidney and both ureters (Fig 376) kidneys and both ureters

GROUP 2 CALCULI IN ONE KIDNEY AFTER REMOVAL FROM OPPOSITE SIDE

GROUP 3 CALCULI IN THE REMAINING KIDNEY, i.e., after opposite nephrectomy

CONTRAINDICATIONS IN SUBGROUP 1A BILATERAL RENAL

In the case of multiple large phosphatic calculi on both sides, with infection by urea-splitting bacteria, which cannot be controlled and the renal function on both sides is poor as the result of advanced pathological changes. The persistent infection and the condition of the kidney favor early recurrence

advisable to resect the kidney and close the defect by the method shown in Chapter 53. It is better to make multiple small nephrotomy incisions to remove calculi in calices if they cannot be reached through the pyelotomy incision, than to attempt to use a large nephrotomy incision. We prefer a posterior pyelotomy but some operators, Illyes, routinely employ the anterior approach to the pelvis.

We are not convinced that the removal of large branching calculi serves any useful purpose, because the chances of early recurrence make such operations inadvisable. Branching (coral) calculus is rarely as great a cause of destruction of the kidney as is a relatively small calculus which blocks the outlet of the renal pelvis.

Treatment of Bilateral Calculi

These cases as seen clinically can be placed in three groups, as follows

GROUP 1 Various combinations including calculi (a) in both kidneys (Figs 531, 537, and 541) (b) in both kidneys and one ureter, (c) in one kidney and opposite ureter (Fig 375), (e) in both ureters, and (f) both

In cases of large branching calculi in the presence of the concomitant conditions just mentioned

We are cognizant of efforts to improve function in the above two groups by nephrostomy but do not coincide with the opinion that any but the indications to be enumerated permit attempts to remove the calculi

INDICATIONS IN SUBGROUP 1A BILATERAL RENAL

In a case in which there are one or several relatively small calculi on one side and a large branching one on the other as in Fig 541, removal of the small ones is indicated if urography shows that they obstruct the ureteropelvic junction of that side

Again operation is indicated if there is a triangular oval or round calculus in the pelvis on one side and one or several small ones on the opposite one. The side should be operated first where the pelvis is blocked and the other as soon as possible afterwards (4-5 weeks). In a case of this type (Fig 531) we intended to follow this plan but the calculus in the left kidney which was in the inferior calyx at the time the right side was operated moved down into the ureter on the sixth day followed by an anuria so that immediate ureterotomy became necessary because a ureteral catheter could not be passed beyond the calculus in the left ureter. In a second case the general condition



FIG. 540—Specimen of kidney removed at secondary operation after pyelotomy for calculus eighteen months previously. There was a recurrence in form of a large phosphate calculus. Note marked thickening of wall of renal pelvis.

of the patient did not permit operation on the second kidney until five months later when we were obliged to intervene because of a blockage of the ureter and resultant very severe acute pyelonephritis. In both these cases removal of the calculi from both sides as advised by Hryntschak and others, might have been advisable but in general at least in the United States few operators attempt to do this

INDICATIONS IN SUBGROUP 1B CALCULI IN THE TWO KIDNEYS AND ONE URETER

In non urgent cases, i.e. those requiring immediate removal of a renal calculus on one side it is advisable to remove the ureteral calculus. If it is in the pelvic portion of the ureter manipulative removal can be tried but if higher only ureterotomy should be done. If the ureteral calculus is not eliminated first as a cause of obstruction removal of a calculus from the opposite kidney will throw all of the work on the kidney whose ureter is blocked and anuria will result

INDICATIONS IN SUBGROUP 1C IN ONE KIDNEY AND OPPOSITE URETER (Fig 375)

Remove calculus in the latter first

INDICATIONS IN SUBGROUP 1D IN BOTH URETERS AND ONE KIDNEY

Remove by manipulation or operation the calculus on the side where there is no renal calculus

INDICATIONS IN SUBGROUP 1E CALCULI IN BOTH URETERS (Fig 376)

Both should be removed at the same operative sitting

INDICATIONS IN SUBGROUP 1F CALCULI IN BOTH URETERS AND BOTH KIDNEYS

Remove ureteral calculi first

INDICATIONS IN GROUP 2 CALCULI ON ONE SIDE ONLY FOLLOWING REMOVAL ON OPPOSITE SIDE

FIG 542

FIG 541



FIG 541—Plain radiographs of case of bilateral renal calculi presenting a problem as to operative measures. In the right kidney there was a triangular calculus (indicated by arrow) blocking the outlet of the pelvis and a second calculus in an upper calyx. The pelvis and calices of the left kidney were completely filled by a coral-like or branching calculus. The only operative indication was to first remove the right sided calculi and after restoration of function to perform a left nephrectomy.

FIG 542—Case of bilateral renal calculi. A calculus had been removed ten years before, from left kidney. The pyelogram reveals secondary atrophy, only the pelvis remaining intact. On the opposite side, a small calculus shadow is seen separated from pyelographic medium, indicating a stricture of calyx, a diagnosis, which was confirmed at operation.

If one is sure that there are no calculi on the operated side, a ureteral calculus on the nonoperated side should be removed first before attempting to operate on the corresponding kidney for calculi.

INDICATIONS IN GROUP 3 CALCULI IN URETER OR KIDNEY FOLLOWING OPPOSITE NEPHRECTOMY

Immediate operation is indicated if either anuria (Chapter 47) or symptoms of acute renal infection are present, otherwise the operative indications are the same as mentioned under those for unilateral calculi.

There appears to be a marked tendency for calculi to form in the remaining kidney following nephrectomy for nephrolithiasis, and nontuberculous or tuberculous infection. Of 19 cases of anuria reported by Illyes (Zeit Urol Chir 1932, 34, 1) a calculus was found in the ureter or kidney on the remaining side.

RECURRENCE AFTER OPERATION

Incidence Recent statistics of cases that have been followed show a variation in incidence of recurrence varying from 8.3 per cent to 21 per cent. The

lowest percentage is that of Illyes (1934) of 8.3 per cent in 591 cases and the highest that of Key reported by Hellström (1933) of 21 per cent in 220 cases. Other statistics are those of Braasch and Foulds (1924) of 14.2 per cent in 677 cases, and Lowaley and associates reported by Twinem (1937) of 20.4 per cent in 202. In these figures the appearance of calculi postoperatively in the opposite kidney. It is of interest to note that of 15 operations for large branching calculi there are six recurrences.

In general the percentage of recurrence after nephrotomy is higher than after pyelotomy. The latter has become the operation of choice in the majority of clinics as is shown by a report of 500 cases reported by Priestley (Mayo Clin. Bull. Aug. 18, 1934). Pyelotomy was employed in 44.6 per cent and nephrotomy in only 3 per cent of the cases.

FALSE RECURRENCES

This term is used to designate the cases in which calculi have been overlooked at operation.

Prevention. The number of recurrences of this etiology has been greatly reduced since pyelotomy has been generally adopted as the method of choice and since the introduction at some clinics of facilities to make fluoroscopic examinations and film exposures of the kidney during operations.

The experience of The Mayo Clinic in attempting to reduce the number of false recurrences is given in two reports: one by Braasch and Carman in 1924 and a more recent one by Sutherland (Jour. Urol. 1935, 33, 1). The latter states of 1061 cases up to 1924 a single shadow was visible on the film taken before operation but several calculi found at operation in 146 cases; whereas in 66 others the reverse was true, i.e. several shadows on the pre-operative film and only a single calculus at operation. Finally no shadows were visible on the pre-operative film and one or more calculi found at operation in 21 cases.

Since 1924 both the fluoroscopy and film methods were used during the operation. In 70 (14 per cent of 479 cases) fluoroscopy failed to reveal any remaining shadows which were found on the films. At times shadows of calculi are seen on the film but the operator cannot locate the calculi. Examination of the removed kidney revealed the presence of calculi either incarcerated in minor calices or lying well encapsulated in the renal parenchyma. Recently both fluoroscopy and the film method are routinely employed at The Mayo Clinic. The film (10 x 12 inches) is not placed in close contact with the exposed kidney but against the side of the patient. In order to immobilize the kidney a special aluminum clamp is used.

A frequent cause of false recurrence is that a small calculus may be hidden behind a larger one only the latter showing on the preoperative film.

TRUE RECURRENCES

These are always due to one or a combination of the following causes:

Persistence of Infection. Failure to eliminate infection due especially to the urea-splitting types of bacteria is responsible for the recurrence of phosphatic calculi. These bacteria alkalinize the urine thus favoring the precipitation of phosphates (ammonium, magnesium and calcium). Recurrence is more common in cases of infection by urea-splitting bacteria (proteus, certain strains of staphylo-

cocci) than when *B. escherichia* or *Aerobacter aerogenes* or non-urea-splitting staphylococci are present. Commendable efforts are being made in this group of cases to eliminate the infection, but in a certain number the urine remains alkaline in spite of every method employed to acidify the urine and thus create unfavorable conditions for the development of the various strains of *B. coli* which multiply more rapidly in alkaline urine as well as equally unfavorable conditions for the development of the urea-splitting bacteria.

Persistence of Pathologic Changes in Kidney This is a factor in true recurrence which is not generally appreciated by those who maintain that recurrences can be greatly reduced by postoperative therapy. The inflammatory changes in the walls of the renal pelvis and calices previously described (See also Figs 539 and 541) are often of such a permanent character that they favor stasis and thus indirectly the persistence of infection. In addition to the changes in the renal pelvis and calices, those in the parenchyma have weakened the ability of its reticulo-endothelial system to combat infection. Finally, replacement lipomatosis (Fig 523) in chronic infection associated with calculus formation and the almost inevitable perirenal and peripelvic sclerotic changes all favor reinfection or persistence of infection with resultant calculus formation. Similar changes in the ureteral wall complicate the problem still more.

Stasis Due to Mechanical Obstacles or to Neurogenic Dysfunction Unless every source of obstruction such as abnormal vessels, strictures, etc. distal to the kidney are eliminated, true recurrence is sure to take place. The same is true of neurogenic dysfunction which like a mechanical obstruction interferes with normal peristalsis of the renal pelvis, ureter and of the bladder.

Other Causes of Recurrence Under this heading can be placed disturbances of metabolism such as those incident to hyperparathyroidism, excessive elimination of oxalates, phosphates and uric acid.

The Prevention of Recurrence After Operation The following measures which aim to reduce the present relatively high percentage of recurrence are being employed in a number of American clinics.

A BEFORE, DURING AND IMMEDIATELY AFTER OPERATION

- 1 Preoperative examination to include estimations of the calcium, phosphorus, uric acid, creatinine and sugar content of the blood (see Diagnosis)
- 2 Smears and cultures from the ureteral urine before and from the renal pelvis during operation
- 3 Determination of the pH of the ureteral urine on the side where the calculus is located
- 4 Lavage of the renal pelvis at operation and through the nephrostomy tube after operation
- 5 Chemical analysis of calculus (see page 748), the dietary regimen (see below) to be governed by the results of this analysis, the pH of the urine and the results of the bacteriological examination of the urine before and during the operation

B POSTOPERATIVE PREVENTIVE CARE

- 1 ELIMINATION OF FOCAL INFECTION, especially of the prostate, seminal vesicle and cervix uteri
- 2 TREATMENT OF ANY CONDITION (mechanical or neurogenic) WHICH FAVORS INFECTION BY STASIS Under this heading are included ureteral dilatations, treat-

ment of any cause of neurogenic dysfunction especially syphilis of the spinal cord (Fig. 478) or any source of peripheral obstruction.

3 **DIETARY MANAGEMENT**¹ Patients with calculi composed of calcium and magnesium phosphates or carbonates which form in an alkaline urine or oxalates which are precipitated in a wide range of urinary reactions are placed on the high Vitamin A acid ash diet (page 765) so as to shift the urinary reaction strongly to the acid side. The basic diet which is used in these cases has an excess acid-ash of 17.3 cc. but the constituents of the diet however are varied daily according to the pH of the urine until a level of from 4.8 to 5 is maintained. As a general rule, an excess acid-ash of 28-30 cc. is necessary to keep the pH at this point. If the high Vitamin A acid ash diet alone does not suffice to lower the urinary reaction to at least 5.2 enteric coated tablets of ammonium chloride in doses not to exceed 6 Gm. daily must be added, watch being maintained for signs of acidosis and also by inspection of the urinary sediment to be certain that urates and uric acid crystals are not present.

When the calculi are composed of cystine or uric acid (both of which form in an acid urine) the pH is shifted slightly to the alkaline side by use of the high Vitamin A, alkaline-ash diet again ascertaining that phosphates and carbonates are not being precipitated at that degree of alkalinity. Vitamin A is given in the form of haliver oil or carotene in-oil capsules and the Jeans (biophotometer) test is used to make certain that adequate amounts have been given. The patient is taught to make pH determinations of the urine (with an apparatus manufactured by the La Motte Chemical Products Company) which is voided one half hour before lunch in order to avoid the effects of the alkaline tide. According to Higgins recurrent calculi are composed chiefly of calcium and magnesium phosphates carbonates and traces of oxalates which form in an alkaline urine. By shifting the reaction of the urine to the acid side their recurrent formation should be minimized.

4 **RADIOGRAPHIC SURVEILLANCE OF OPERATED CASES** A plain film exposure should be made of patients before discharge from the hospital and at intervals of four months.

5 **USE OF DRUGS AND PELVIC LAVAGE.** If the causative organism belongs to the *Staphylococcus* and *Streptococcus faecalis* groups the intravenous administration of 0.3 Gm. of neosarsphenamine every five days for 4-6 doses is often very effective in eliminating this type of infection. The use of ammonium chloride as an adjuvant in cases where the high Vitamin A, acid ash diet does not succeed in lowering the pH of the urine sufficiently to prevent growth of urea-splitting bacteria has already been referred to. Higgins believes that the use of this drug as an acidifier should be avoided if possible because of its irritant action on the gastrointestinal tract when given in sufficiently large doses to be effective. Lavage of the renal pelvis with mild antiseptic solutions such as 1:100 to 1:1000 nitrate of silver 1-4000 acroflavin etc. is still employed in many clinics.

We are indebted to recent articles by Higgins and by Keyser for material included in this paragraph.

Lipoma Although a perirenal lipoma is not as rare as formerly believed, comparatively few cases of intrarenal lipoma have been reported. Pemberton and McCaughn (*Surg Gynec and Obst*, 1933, 56, 110) found only two intrarenal as compared to forty cases of perirenal lipoma observed at The Mayo Clinic. A typical case of a very large intrarenal lipoma was reported by Lower and Belcher (*Surg Gynec and Obst*, 1927, 45, 1). The tumor was a fibrolipoma weighing 420 Gm and had produced a urographic deformity resembling that of a malignant neoplasm. These authors found reports of five other cases of intrarenal lipoma.

MALIGNANT NEOPLASMS OF THE PARENCHYMA

The classification of the different types in this group of renal tumors has been, and still is, the subject of much difference of opinion. There is none as to the necessity of placing in separate sub-groups, (a) the pure and mixed types of sarcoma to be mentioned later, usually found in adults, and (b) the embryonal adenosarcoma (Wilms tumor), almost invariably found in children.

The discussion involves chiefly the type of neoplasm which has hitherto been termed hypernephroma or hypernephroid neoplasm. At present, there are the following theories as to their pathogenesis.

THEORIES OF PATHOGENESIS All hypernephromas are carcinomas because they have their origin in the renal tubules, as claimed by Sudeck, Stoerk and Oberzimmer (*Virch Arch Path Anat*, 1926, 260, 176). All hypernephromas are the result of malignant changes in aberrant adrenal rests, as occur in similar adrenal inclusion tumors of the spleen,

liver, pancreas, ovary, etc. This is the contention of those who support the theory of Grawitz.

In the following classification, we have followed the former of these two theories, viz., that all carcinomas of the kidney originate from the renal tubules and not from inclusion of adrenal rests.

A Carcinoma

- 1 Papillary adenocarcinoma (Figs 544 and 545)
- 2 Alveolar adenocarcinoma
- 3 Malignant papillary cystadenoma

B Sarcoma, including round and spindle-celled, as well as the mixed types

C Embryonal adenosarcoma (Wilms tumor)

The salient pathologic features of these groups will be discussed in the order just enumerated.



FIG 545—Papillary adenocarcinoma of kidney, formerly termed hypernephroma. Note invasion of perirenal tissues and on the right, a narrow rim of compressed parenchyma.

CARCINOMA

This group includes the majority of neoplasms formerly called hypernephromas. The group includes

1 **Papillary Adenocarcinoma.** According to Ewing there is a clear and a granular-cell variety. They form more or less solid tumors the clear-celled variety being very vascular with marked tendency to hemorrhage, necrosis and cystic softening. They are usually composed of branching villi lined by a single layer of clear or several layers of granular cells. There is less tendency to hemorrhage or cystic change in the granular than in the clear-celled type.

2 **Alveolar Adenocarcinoma.** These form only a small proportion of tumors of the kidney. They are of homogeneous whitish appearance and infiltrate diffusely breaking through the capsule and invading the pelvis at a comparatively early stage. Hemorrhage and cyst formation is rare. These tumors probably originate from well-differentiated blastema or from adult cortical tubules (Ewing). Histologically the alveolar carcinoma shows less cellular differentiation, the cells being arranged in alveolar or tubular fashion.

3 **Malignant Papillary Cystadenoma.** These resemble similar growths of the ovary representing a malignant change in a benign cystadenoma (Fig. 543). They are well encapsulated, single or multiple and at times very large. The papillary and cystic character is evident on gross inspection. Histologic examination reveals a variety of pictures (McKenzie and Waugh, *Jour. Urol.*, 1927, 18:331). The various steps of adenoma, cystadenoma, cystadenoma papilliferum and cystadenoma papilliferum malignum can be seen on the same slide.

Stirling (*Jour. Urol.* 1927, 17:165) collected 30 cases and reported a personal observation in which a filling defect seen in the urogram was found at operation to be due to an invasion of the pelvis.

SARCOMA

These are relatively uncommon if the embryonal adenosarcomas as seen in children are excluded. Only 20 sarcomas were found by Judd and Donald (*Ann. Surg.* 1932, 96:1028) in a series of 570 renal neoplasms operated at The Mayo Clinic. The reported cases include the following varieties: (a) Spindle and round cell; (b) mixed tumors such as fibrosarcoma, myxosarcoma, fibromyxosarcoma, leiomyosarcoma, lymphosarcoma, fibrosarcoma, fibrosarcoma.

Kretschmer (*Jour. Urol.* 1936, 36:99) found five cases of sarcoma with observation. Mintz (*Ann. Surg.*, 1937, 105:521) was only able to find reports of 93 cases of all types of sarcoma in patients over 21 years of age. Only three lived more than five years after operation. One of us has recently (*Jour. Urol.* 1937, 38:357) reported a case of spindle cell sarcoma alive eight years after operation.

EMBRYONAL ADENOSARCOMA ALSO TERMED WILMS TUMOR

Almost all of the solid tumors of the kidney in children are of this variety (See Chap. 46). The average age at which they are recognized is three years. From the seventh year there is a steady decrease in incidence until puberty and thereafter Wilms tumor is extremely rare according to Campbell (*Pediatric Urology* 1937, 2:256). The tumor is usually unilateral but it was bilateral in two (12 per cent) of 17 cases reported by Kretschmer and Hibbs (*Surg., Gynec. and*

Obst , 1931, 52, 1) In some of the cases reported as bilateral, the necropsy findings indicate a probable metastatic rather than a primary bilateral condition

That these tumors are not rare in children is shown by the fact that over 100 cases were published between 1924-31 according to Crabtree and Prather (Jour Urol , 1931, 25, 589) Campbell (loc cit) has observed 51 adenomyosarcomas and one papillary adenocarcinoma (male, 7 years) In the majority of reported cases, the tumor was large and the growth a rapid one The embryonal adenosarcoma presents a smooth less often a lobulated surface and on section appears soft and greyish-white, but areas of hemorrhage or necrosis may be seen in

some cases The predominating histological picture is that of an alveolar sarcoma in which the epithelial complexes (Drusenschlauche) are found according to Lieberthal (Surg , Gynec and Obst , 1931, 53, 77) These epithelial complexes are the keynote of the tumor and assume various forms, such as (a) an arrangement of the round cells in rosettes, suggesting epithelium, (b) the cells are more cuboidal, being arranged in tubular acini, and (c) cylindrical epithelium and a well defined basement is found Both smooth and striated muscle fibers are frequently seen in the connective tissue framework of the alveolar cell nests According to Wilms, striated muscle occurs in about 40 per cent of the cases Myxomatous connective tissue, fat and cartilage may also be present in the coarser supporting



FIG 546 —Large papilloma of renal pelvis causing hydronephrosis (After Brutt)

framework A tumor may begin as an embryonal adenosarcoma but as the result of certain tissues growing more rapidly than others, may end up as a rhabdomyoma, a myxosarcoma, a fibrosarcoma, a round cell sarcoma or a carcinoma

NEOPLASMS OF THE RENAL PELVIS

PAPILLOMA

This is the most common type (Fig 546) of neoplasm of the renal pelvis Of 45 cases of pelvic neoplasms observed at the Mayo Clinic from 1907-1933, the papillomatous type was found in 33 or 73.3 per cent according to Cabot and Allen (Lancet, 1933, 2, 1301) A series of 74 papillomatous tumors of the renal pelvis,

including two personal cases was studied by Kimball and Ferris (Jour Urol, 1934 31 257) Of these 74 cases the proportion of males to females was 3 to 1, i.e. 74.4 per cent to 25 per cent As to age, 54 per cent were between 50 and 70 years and 31 per cent between 30 and 50 years The gross and histologic appearance of both the benign papilloma and papillary carcinoma of the renal pelvis do not differ in any respect from those of the same types of vesical neoplasms described in Chap 27 so that it will be unnecessary to repeat them here Their size varies from a small tuft to a mass filling the entire pelvis (Fig 546)

Clinical Effects Papillomatous tumors of the renal pelvis are of clinical interest (a) because of their tendency to occlude the outlet of the renal pelvis with resultant hydronephrosis (Fig 546) (b) the pressure atrophy of the parenchyma and (c) the frequency of coincident implantation metastases in the ureter or bladder or both.

The implantation tumors in the bladder may be either single or multiple being usually situated near the corresponding ureteral orifice The latter and the adjacent bladder were involved in 48 per cent of the 74 cases studied by Kimball and Ferris Other parts of the bladder some distance away from the involved ureteral orifice were the seat of tumors in 36 per cent of the 74 cases On the other hand it is of importance to note that in 14 per cent growths were found in the bladder without any lesion of the ureteral orifices The frequency (48 per cent) of implantation metastases involving or close to the ureteral orifices emphasizes the necessity of keeping in mind the possible existence of a primary tumor in the renal pelvis whenever one or more papillomas are found close to a ureteral orifice.

SQUAMOUS-CELL CARCINOMA

This type of neoplasm (Fig 547) is found much less frequently than the benign and malignant papilloma (Fig 548) Gilbert and MacMillan (Ann. Surg 1934 100 429) were only to find reports of 55 cases to which two personal observations were added The neoplasm is very firm but may attain a large size Invasion of the parenchyma occurs oftener than in the papillomatous type of pelvic neoplasm There is a distinct etiological relation between squamous cell carcinoma of the renal pelvis and certain factors like infection calculus formation and leukoplakia Infection was present in 39 per cent of the 56 cases studied by Gilbert and Macmillan (loc. cit.) calculi as a coincident condition was noted in 30 (52 per cent) of 57 cases and leukoplakia in 3 cases.

The role played by these three forms of chronic irritation seems to be less important in papillomatous tumors of the renal pelvis than in squamous-cell carcinoma.

MULTIPLE NEOPLASMS

COINCIDENT NEOPLASMS

That primary neoplasms may occasionally be found in both the renal pelvis and parenchyma is shown by the following combinations thus far reported

Patch and Rhea's cases of benign papillary cystadenoma of parenchyma and benign papilloma of pelvis

Graves and Templeton's case of hypernephroma and carcinoma of pelvis

Balch's case of hypernephroma and papillary carcinoma of pelvis

Gottstein's case of sarcoma of parenchyma and papillary carcinoma of pelvis

A most unusual case is that reported by Chwalla of two independent primary tumors of the parenchyma, a sarcoma and a hypernephroma. Only two similar cases have ever been published.

BILATERAL RENAL NEOPLASMS

This is rare, less than 30 cases having been observed. Nicolich (*Zeit. Urol.*, 1929, 23, 477) reported a case of bilateral lymphosarcoma and one of round celled sarcoma. He found reports of 17 other bilateral renal neoplasms. Sprenger and Bohrod (*Jour. Urol.*, 1935, 33, 427) observed two cases of papillary adenocarcinoma. Hotolmei and associates reported (*Presse Méd.*, 1937, p. 332, March 3) an unusual case in which a mass was to be felt over each kidney re-

FIG 547



FIG 548



FIG 547—Operative specimen of carcinoma of the squamous-cell type at outlet of renal pelvis with resultant hydronephrosis

FIG 548—Large papillary carcinoma of the renal pelvis blocking outlet of latter with resultant hydronephrosis (Courtesy of Dr. Harry Culver)

gion, accompanied by pain and hematuria. Retrograde urography revealed a deformity on both sides. The diagnosis of carcinoma was confirmed by biopsy.

LOCAL AND SYSTEMIC METASTASES

In Papillomata. We have already directed attention to the frequency of implantation metastases in the ureter and bladder in benign and malignant papilloma of the renal pelvis. Such metastases are found far less frequently in

squamous-cell carcinoma of the renal pelvis and are still rarer in carcinoma of the kidney Altstein (*Zeit Urol Chir*, abstracts 1937 43 172) reports a case of a bean sized ureteral metastasis 3-4 cm below the ureteropelvic junction In a case of papillary adenocarcinoma (hypernephroma)

Papillary Adenocarcinoma and Alveolar Carcinoma. Local and systemic metastases occur much more commonly in cases of papillary adenocarcinoma (hypernephroma) than in the alveolar type but the localizations of the metastases are the same in both types Extension to the perirenal tissues and to the main renal veins is more often observed in papillary adenocarcinoma (hypernephroma) Involvement of the lymph nodes around the renal pedicle is soon followed by that of the preaortic and other abdominal lymph nodes In a case of papillary adenocarcinoma observed by us the enlarged lymph nodes compressed the ureter to such an extent as to give rise to a hydronephrosis (Fig 558) Systemic metastases may involve any structure in the body but most frequently the lungs, bones and lymph nodes as shown by a recent study of 20 cases of papillary adenocarcinoma (hypernephroma) with metastases made by Schinz and Uehlinger (*Acta Radiologica* 1933 14 56) Pulmonary metastases were found in 75 per cent bone metastases in 50 per cent and in the lymph nodes in 40 per cent

BONE METASTASES may appear long before there are any symptoms pointing to the kidney as the seat of the primary neoplasm Such a solitary metastasis was found in the femur five years before the presence of a renal tumor became evident Such solitary metastases may be the only sign of a late (7-10 years) postoperative recurrence Of 10 bone metastases observed by Schinz and Uehlinger, five were solitary Multiple bone metastases are often symmetrically located in the femur or humerus The occurrence of a spontaneous fracture should always lead to the suspicion of a primary neoplasm in the breast thyroid prostate and kidney when not due to hyperparathyroidism or a primary bone tumor Skin metastases are rare hence a case reported by Cochez and Busser (*Arch. Mal Reins* 1933 7 721) is of interest A year after suprapubic prostatectomy a hematuria was noted A month later multiple nodules appeared on the skin of the trunk which were found on biopsy to be metastases of a papillary adenocarcinoma (hypernephroma) as confirmed at necropsy

Tumor thrombus formation in the main renal veins is not an uncommon sequel of neoplasms of the parenchyma Extension into the renal veins was found in 50 of 130 cases operated by Beer (*Surg. Gyn. and Obst.* 1937 65 433) In 8 of the 50 cases the tumor thrombus formation extended into the vena cava inferior

CLINICAL PICTURES

As our experience increases it becomes more and more evident that no single or group of symptoms (syndrome) is characteristic of renal neoplasms whether they arise in the parenchyma or pelvis This is especially true of the three most common symptoms viz. hematuria pain and tumor¹ All are present in so many other renal lesions that it is only by a thorough urologic study (Chapter 11) that a differential diagnosis can be made Keeping this in mind we shall direct

¹Neoplasms of the kidney parenchyma and of the pelvis resemble each other so closely clinically that they are considered together here

attention to a number of clinical pictures in which one of the cardinal symptoms is the outstanding feature. It may be the only symptom present in a given case or as more frequently occurs, be accompanied by one or more other symptoms. For example, hematuria may be the initial and only complaint and thus dominate the clinical picture or hematuria may simply accompany pain, tumor, etc., at some time in the course of the disease. Let us consider the more common clinical pictures and their outstanding features.

HEMATURIA

This is seen as the initial or only symptom in over sixty per cent of all cases. As an associated finding, it is observed in nearly twenty per cent more. There is great variation in the severity and duration of the hematuria. The same is true of its tendency to cease spontaneously and to recur at irregular intervals. As a rule,

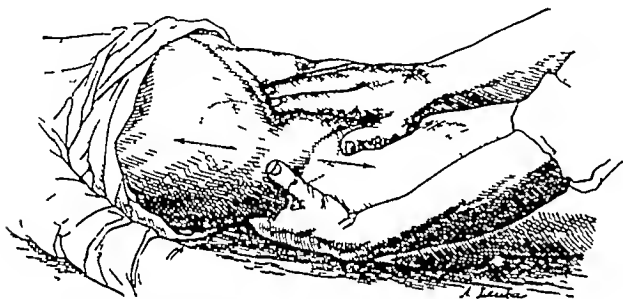


FIG 549—Method of bimanual palpation of the kidney with patient in dorsal (supine) position

the degree of hematuria, i.e., the amount of blood in the urine, is greater in the case of a neoplasm than in any other form of renal lesion causing hematuria. This cannot be utilized, however, for differential diagnosis, because occasionally one will see such a severe hematuria in a chronic hemorrhagic nephritis, in an early (Fig 501) tuberculosis of

the kidney, or even in a polycystic kidney (Fig 469), as to lead one to believe that only a neoplasm could give rise to such a severe hemorrhage from the kidney. The bleeding in cases where the primary tumor is located in the renal pelvis or tip of a papilla (angioma), is easy to visualize. The same is true of cases of malignant tumors which have invaded the renal pelvis but when a severe hematuria occurs under other conditions one can only explain it as due to a passive hyperemia incident to the presence of the neoplasm in the parenchyma.

Symptoms The same explanation probably serves for the hematuria observed in cases of tumors of the true capsule, of the perinephritic tissues and less often of the adrenals. As a rule, the bleeding is symptomless, i.e., it occurs without apparent cause, profusely and continuous, for a period varying from hours to days and then ceases as spontaneously as it appeared. There is nothing typical about the duration, periodicity, intervals of freedom, etc. This is unfortunate from the standpoint of both early recognition and treatment, because it causes both the patient, and only too often the physician first consulted, to postpone an examination as to the source of the bleeding. As the tumor grows, the intervals between the attacks of hematuria grow less and less, until the bloody urine is a constant feature. As was stated above, in a relatively small percentage of cases, the hematuria is not the most prominent feature, but is preceded by pain, tumor, etc., or follows their appearance at a later period. Hematuria as an initial symptom is very infrequent in children.

Color The urine in a hematuria may be only "smoky" when the amount of blood is relatively small, or the blood may only be found on microscopic examination. Usually the urine is dark red or consists apparently entirely of blood with large clots or worm-like casts of the ureter, composed of coagulated blood. The

bladder may be filled with clots and distended to the umbilicus, giving one the impression at times, that the seat of the bleeding is vesical

TUMOR

The presence of an enlargement may be evident on abdominal inspection alone but this is only the exception. Usually one needs palpation (Fig 549) of the kidney region to elicit the presence of the tumor. This is especially true in adults. In children the tumor is the most common initial finding while hematuria is either absent or appears very late in the clinical picture. Tumors arising in the lower pole are detected by palpation at a much earlier period than those of the upper pole, because the latter lies behind the lowermost ribs. One can palpate an enlargement of the kidney in adults at some period of the condition in about eighty five per cent of the cases. In children, this is even higher and a tumor is often the first sign which attracts the attention of the parent or physician. One should always palpate the opposite kidney in order to ascertain whether a possible bilateral polycystic (Fig 470) condition might be present. The consistency and character of the surface as well as the area occupied by the enlargement its mobility disappearance behind costal arch etc should all be determined by palpation. These are all of value in the differentiation of renal from other abdominal enlargements (see Diagnosis). In tumors of the renal pelvis an enlargement of the kidney is, as a rule due to a hemato- or a hydronephrosis (see Pathology)

PAIN

This may like either of the preceding stand out as the principal complaint of the patient. It is of subordinate value as to diagnosis of a renal neoplasm compared to either hematuria or tumor. In many cases there is an absence of pain throughout or it only appears late in the disease when there is invasion of the adjacent nerves or structures such as the colon (Fig 550) stomach etc

Pain is more apt to be due to metastases than to the primary growth. As a rule one finds three types of pain in renal neoplasms independent of those due to systemic metastases. These types of pain are

(a) Neuralgic Pains. These are localized along the course of the ilio-inguinal and iliohypogastric (Fig 18) or the last dorsal or genitocrural nerves. The pain may be continuous but more commonly it is recurrent. Such pains are due to pressure on the corresponding nerve trunks and are of importance from the standpoint of prognosis. Pain along the sciatic nerves (uni or bilateral) or radiating in a girdle like manner from the spine or felt over any osseous structure (skull ribs or long bones) associated with local evidences of a renal neoplasm usually indicates a metastasis. The fact that symptoms of the latter may precede the detection of a primary renal neoplasm by a period of months to years has already been mentioned under Pathology

(b) Dull Aching Pain. This is referred to the involved kidney and may be of a boring or of a more dull aching character

(c) Colicky pain. This is only present during the passage of the worm like or larger clots referred to under hematuria less frequently to particles of tumor tissue. Such colicky pain does not differ in any respect from that seen during the passage of a ureteral calculus or as the result of similar causes of renal and ureteral colicky pain. As in the case of the latter there may be an accompanying reflex

paresis of the intestine, so that the clinical picture may resemble that of a genuine intestinal obstruction. We have observed such a pseudo-ileus with severe pain over the involved kidney, during a massive hemorrhage into a hypernephroid tumor of the kidney.

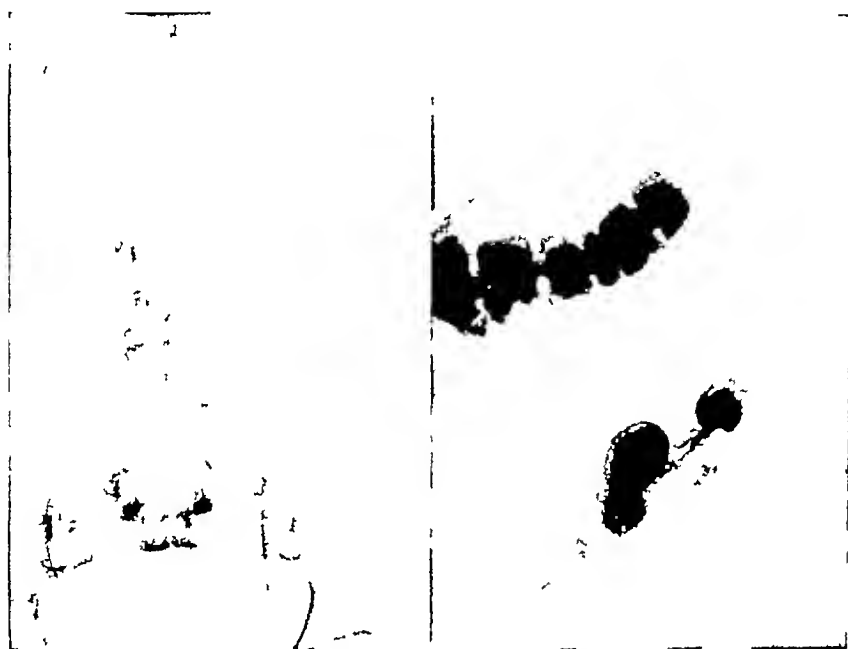


FIG 550—A Only the renal pelvis was filled by the pyelographic medium in a case of hypernephroid renal neoplasm.

B Marked filling defect in hepatic flexure of colon after barium enema, due to pressure of and invasion by renal neoplasm (Courtesy of Dr J S Eisenstaedt)

FEVER

That a rise of temperature may accompany one or more of the above described cardinal symptoms, or may even dominate the clinical picture, is just beginning to be appreciated. James Israel was the first to direct attention to the fact, that fever simulating in every respect that usually seen in renal infections, can at times be observed in renal neoplasms. The fever may be due to a pyelitis, but more commonly it is the result of a toxemia from absorption of necrotic tumor tissue. It may be of the continuous or remittent type.

Scheele has reported a case which lasted for months rising to 104° F every evening. In a case of renal sarcoma observed at Michael Reese Hospital, it led to the erroneous diagnosis of retrocecal appendiceal abscess in a girl of four (Fig 551).

DIAGNOSIS

This is based chiefly upon the following

- 1 The clinical history
- 2 The results of the urologic study (including physical examination)

CLINICAL HISTORY

(a) Hematuria. As was stated above, there is nothing characteristic about this symptom, taken by itself, which enables one to say that it is due to a neoplasm.

Tumor of Kidney with high fever

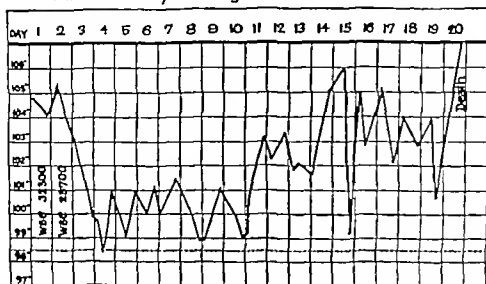


FIG. 551.—Temperature chart from case of mixed cell tumor of kidney in girl four years old with persistent fever (Dr. Lawrence's case.)

FIG. 552

FIG. 553

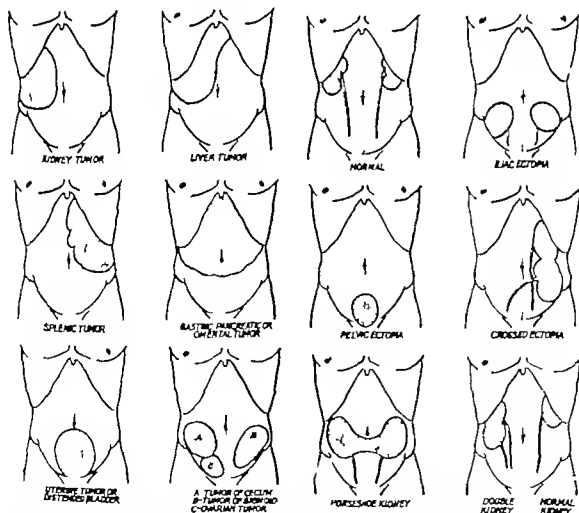


FIG. 552.—Diagrams showing most common locations of tumors of various abdominal viscera in normally located organs (see text under presence of tumor)

FIG. 553.—Location of most common forms of renal anomalies (see Chap. 37). This must be considered in the differential diagnosis of renal from other abdominal tumors (see text)

of the ureter, renal pelvis or parenchyma. It is only by routinely following the various steps, to be described later under urologic study, that a diagnosis can be made in the majority of cases.

(b) **The Presence of a Tumor** There are certain features about an enlargement of the kidney which serve to distinguish it from other abdominal tumors. We have learned, however, not to depend upon the ordinary methods of physical examination, such as inspection, palpation and percussion, for such a differentiation. The more exact methods of diagnosis, which include (a) the examination of the barium filled gastro-intestinal tract (Fig 550), (b) the various

steps of a complete urologic study (see later) and (c) radiography of the chest (Fig 172), skull, long bones, etc, have not completely supplanted the older methods of physical diagnosis, but are indispensable adjuvant procedures.

It is beyond the scope of this book, to enter into a detailed description of the chief diagnostic features of all of the other abdominal conditions giving rise to demonstrable enlargements, which one must consider, in the differential diagnosis of a kidney enlargement, whether it be a true neoplasm, a retention tumor such as a hydronephrosis or pyonephrosis, a renal tuberculosis, a solitary cyst (Fig 466) or polycystic disease (Fig 470), and almost innumerable other lesions.

IN THE DIFFERENTIATION OF A KIDNEY TUMOR, in the larger sense of the word, from other abdominal, demon-

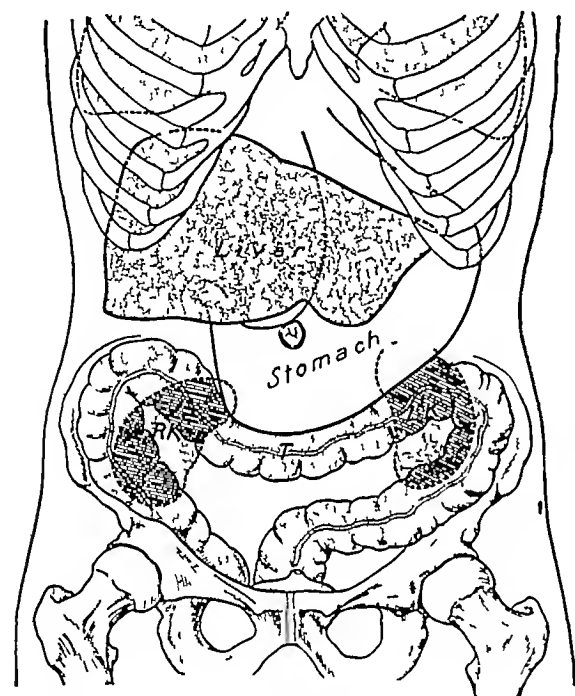


FIG 554—Diagram to show location of abdominal viscera in generalized ptosis of same. This must be kept in mind in the diagnosis of a renal, as well as other abdominal tumors (see text).

strable, enlargements, one must in general take into consideration

(a) Normally located and developed abdominal viscera (Fig 552), (b) kidneys which are displaced as the result of congenital anomalies (Fig 553) and (c) abdominal viscera which are displaced as the result of some condition² such as visceroptosis (Fig 554).

A glance at Figs 552, 553 and 554, will show how necessary it is to bear these in mind, in the differentiation of abdominal tumors having their origin in other abdominal viscera, from those of renal and pararenal origin. The chief physical characteristics of the two last named (when the kidney is normally placed and developed), are the following:

Location in the respective upper quadrant of the abdomen

Ability to palpate the enlargement bimanually (Fig 549) as arising from the posterior abdominal region

² In Chapter 35 on Mobile Kidney, we have considered this as the result of a constitutional congenital condition, i.e., a lack of development of mesenchymal (fibrous and elastic) tissues.

A more lateral position than is true of most tumors of intraperitoneal origin and the ability to secure ballottement (unless tumor fixed) by bimanual manipulation (Fig 549)

The disappearance of the tumor behind the costal arch

WE WILL SIMPLY ENUMERATE THE TUMORS² WHICH ONE MUST CONSIDER IN DIFFERENTIAL DIAGNOSIS DURING PALPATION ETC., OF A SUSPECTED RENAL TUMOR³

FIG. 555

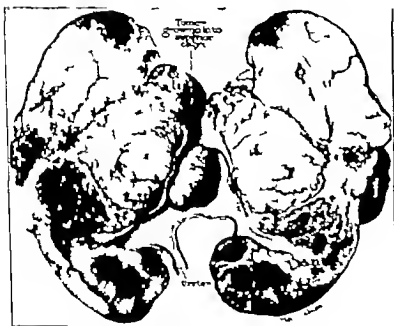


FIG. 555.—In the upper illustration is seen a pyelogram with a marked filling defect of upper major calyx.

Below is to be seen the kidney from same case with large hypernephroid tumor occupying its upper two thirds and growing into superior calyx, which explains the filling defect in the pyelogram.

FIG. 556.—Normal pyelogram of the "pseudo spider" type. This patient had a chronic renal infection and repeated pyelograms over a period of three years always revealed the same pyelographic pictures.

FIG. 556



cysts and neoplasms appendiceal abscess (especially retrocecal) spleen and encapsulated tuberculous peritonitis

(c) Pain. As in the case of hematuria, there is nothing characteristic about this symptom far less than is true of tumor. The neuralgic, dull aching and colicky pains are all present in so many other renal and extrarenal conditions as to be of little diagnostic value when considered alone.

The word "tumor" as employed here, simply means enlargement and includes neoplasms, inflammatory changes or retention tumors

UROLOGIC STUDY

This should be carried out in the order already outlined in Chapter 10, and, in the case of a suspected renal neoplasm, yields the following data from which to make a diagnosis

(a) **Palpation, etc., of the Abdomen** This should be routinely done. If the enlargement presents all of the features outlined above, as suggestive of a renal neoplasm, the finding is of great value, when taken in conjunction with

other objective ones. If the surface is nodular and hard, it may be equally as well due to a polycystic kidney as to a malignant neoplasm. With increasing experience, we have learned to seldom attempt to make a differentiation of types of renal enlargement, by palpation alone.

(b) **Examination for Metastases**

This ought to be the first step if one suspects the presence of pulmonary, osseous or similar metastases.

If any of the symptoms or findings upon examination of the body in general, point toward such metastases, a complete radiographic study of the lungs, bones, etc., should precede the examination of the genito-urinary tract.

(c) **Value of Presence of Symptomatic Varicocele**

Palpation of the external genitalia, and in the male of the prostate and vesicles, should be done routinely. Formerly, the presence of a left sided varicocele was thought to be of much confirmatory value in the diagnosis of a renal neoplasm of the corresponding side. It was the result of the blocking of the spermatic vein by a tumor thrombus in the renal vein. It is so rarely present, that

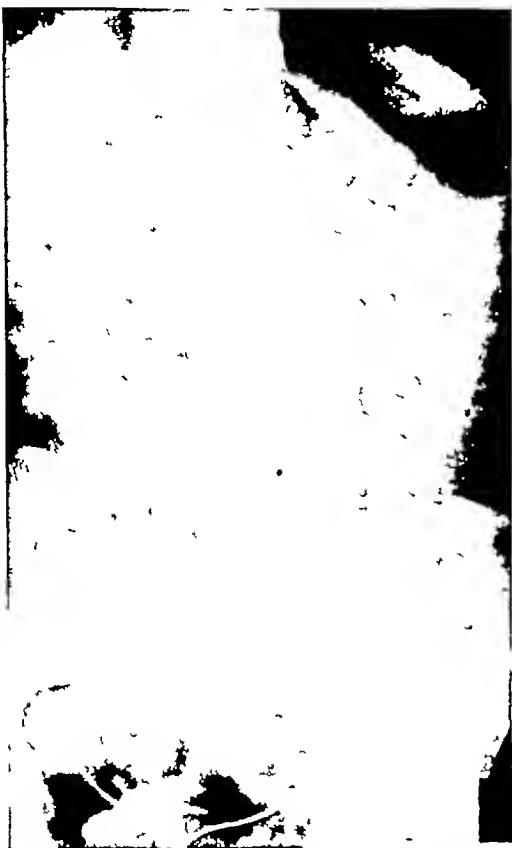


FIG 557—Unusual urographic deformity with displacement mesially of the ureter in a papillary adenocarcinoma (see text) at lower pole of kidney

its diagnostic value is considered of minimal value.

(d) **Cystoscopy and Ureteral Catheterization** There is nothing characteristic about the urine in cases of suspected renal neoplasms. The same is true of cystoscopy, unless one finds one or more papillomata in close relation to, or even protruding, from the ureteral orifice of the suspected side. One must not forget, however, that as in a recent case of ours, a primary vesical neoplasm (squamous celled carcinoma) may arise from the lips of the ureteral orifice. If a bloody efflux is seen from one ureteral orifice (Plate 12), this is of much assistance in locating the source of the bleeding, but not as to whether it is due to a neoplasm of the ureter or renal pelvis.

(e) **Ureteropyelography** One can see calcified areas in a hypernephroid

tumor but so seldom does this occur that plain radiography may in general be said to be of little assistance in making a diagnosis.

The opaque ureteral catheter is of much value alone or better in conjunction with ureteropyelography (see below) Marked displacement of the catheters toward or away from the median line of the body, when associated with a normal



FIG. 558.—Unusual pyelogram in a case of hypernephroid neoplasm of kidney. It simulates that seen in hydronephrosis and was due to a blocking of the outlet of the renal pelvis by malignant lymph nodes at renal pedicle.

pyelogram means that the suspected neoplasm is not of renal origin but probably a retroperitoneal sarcoma (Fig 138) or cyst which has perhaps rotated the kidney but not altered the outline of its pelvis or calices. If the tumor is however of renal origin and especially if it is quite large one often observes a considerable displacement (Fig 563) of the opaque catheter on the corresponding side associated with one of the deformities (see below) typical of a renal neoplasm.

UROGRAPHY We have at our disposal the excretory and retrograde methods. The former can be used first and may yield sufficient data upon which to base a diagnosis if the changes (to be mentioned below) in the urogram are very marked

but in order to visualize finer changes in the calices, the retrograde is to be preferred either employed alone or as a check on the excretory method. The latter has one advantage, in being able to visualize the presence of bilateral cystic kidneys or a congenital anomaly.

Beer (loc cit) in reviewing 16 cases in which there was renal vein involvement, found that in 8, there was no visualization of the involved kidney when excretory urography was employed, whereas in 22 cases where the renal veins were empty, only two failed to visualize.

The chief urographic changes are the following:

a. CHANGES IN THE COURSE, SIZE AND CONTOUR OF THE URETER

b. CHANGES IN THE POSITION AND IN THE DEGREE OF ROTATION, OF THE KIDNEY

c. ALTERATIONS IN THE SIZE AND CONTOUR OF THE RENAL PELVIS AND ITS CALICES

THE TYPICAL PYELOGRAPHIC ALTERATIONS⁴ as seen in renal neoplasms, can be grouped thus:

FIG 559—"Spider" like deformity of pyelogram is typical of hypernephroid tumors of kidney (Dr Harry Culver's case)

(A) **IMITING DEFECTS** (Fig 555) due to the invasion of the pelvis proper or one or more of its major or minor calices, by the neoplasm, so that the opaque medium⁵ fails to enter the occluded portion.



FIG 560—Pyeelographic changes in renal neoplasms

A. Irregularity at lower pole

B. Distortion of all calices

C. Bizarre elongation of calices. In all of the above, a hypernephroid tumor was found at operation.

(B) **"SPIDER"** (Fig 559), **"Dragon"** (Figs 471 and 472), **"Carnation"** (Fig 561) deformities, due to the elongation and compression of the renal pelvis and its calices by the neoplasm (Fig 550). One might call all of these **"Distortion"** deformities, but the terms given are more descriptive of the resemblance to familiar objects.

(C) **RETENTION PYELOGRAMS**, due to occlusion of the outlet of the renal pelvis

⁴ For variations in normal pyelograms, and technique of ureteropyelography, see Chapters 2 and 7 and Fig 556.

⁵ In a few cases the entire pelvis is so invaded or occluded that the pyelographic medium fails to enter at all.

(ureteropelvic junction) either by a tumor arising from within the pelvis itself i.e., intrinsic occlusion or to compression of the uppermost portion of the ureter by the neoplasm i.e., extrinsic occlusion. In either instance the resultant pyelogram (Figs. 558 and 562) resembles that observed in hydronephrosis. This retention type of pyelogram is a frequent finding in benign and malignant epithelioma of the renal pelvis.

OTHER CONDITIONS SIMULATING THE PYELOGRAPHIC DEFORMITIES OF RENAL NEOPLASMS In several recent contributions¹⁴ we have called attention to possible errors and since publication of these papers have

FIG. 561



FIG. 562



FIG. 561—A peculiar pyelographic deformity occasionally observed in hypernephroid neoplasms of the kidney and termed by German urologists *carination deformity*. Note displacement inwards of the ureter.

FIG. 562—Unusual pyelogram in a case of hypernephroid tumor of kidney. The pyelogram resembles that of an ordinary hydronephrosis. The obstruction at outlet of renal pelvis was due to pressure of malignant lymph nodes at hilum.

encountered several similar sources of error in the diagnosis of renal neoplasms based chiefly upon pyelographic evidence. These potential sources of error are

1. A BLOOD CLOT OR INFLAMMATORY EXUDATE in the renal pelvis and its calices gives rise to filling defects and distortion deformities¹⁵ closely resembling those seen in neoplasms.

¹⁴ Eisendrath and K. H.—Pyelographic errors in the diagnosis of renal neoplasms. *J. Urol.* 1925, 14, 615 (Dec.).
¹⁵ Eisendrath and K. H.—Pyelographic diagnosis of renal and pararenal neoplasms. *J. A. M. A.* 1926, 8, 1642 (Nov. 13).

2 PERIRENAL SCLEROSIS (fibrous perinephritis) and even a perinephritic abscess can cause distortion (Fig 498) of the pelvis and its calices

3 A RENAL TUBERCULOSIS (Fig 508) OR AN ATROPHIC PYELONEPHRITIS (Fig 483) may cause marked deformity

4 A PERIPELVIC CYST OF CONGENITAL ORIGIN may, when it causes deformity in the pyelogram, and is accompanied by hematuria lead to an erroneous diagnosis

5 PSEUDO-SPIDER PYELOGRAM One must always bear in mind a peculiar type of normal pyelogram to which we have given the name Pseudo spider (Fig 556)

TREATMENT

The only prospect of prolongation of life or permanent cure in cases of malignant neoplasms of the kidney, at present is nephrectomy. Until irradiation alone or this method of treatment followed by nephrectomy show end-results comparable with those of nephrectomy alone, they cannot be offered to the patient as substitutes

NEPHRECTOMY

The contraindications to nephrectomy can be placed in two groups

1 Those which can be recognized before operation

2 Those which are found at operation

1 Those Which Can Be Recognized Before Operation

(A) SEARCH FOR METASTASES Radiography of the chest should be a routine procedure before every nephrectomy for renal neoplasm because if metastases exist, the lungs are involved in 75 per cent of the cases. The search for bone metastases must be guided by the clinical history of fixed pain in the cases of metastatic deposits in the bones of the thorax, pelvis and extremities and of bilateral radiating pains if a vertebral metastasis exists. In the early stages an area of rarefaction is visible in the long bones, ribs and sternum, later no distinguishing characteristics are present.

(B) EVIDENCE OF BILATERAL NEOPLASMS The urographic deformity in congenital cystic kidneys can be easily distinguished (Figs 471 and 472) from that of a neoplasm.

(C) PATIENTS WHO ARE CACHECTIC and who have shown marked reaction to any preoperative irradiation should not be operated. The same is true of children in whom a marked leukopenia follows irradiation for embryonal adenocarcinoma (Wilms' tumor).

(D) AN OPPOSITE KIDNEY WHOSE FUNCTION IS GREATLY DIMINISHED is also a contraindication as in other patients where nephrectomy is contemplated.

2 Those Which Are Found at Operation

(A) TUMOR THROMBUS IN THE MAIN RENAL VEINS In a recent paper (Surg., Gynec. and Obst. 1937 65 433) Beer states that of 130 nephrectomies reviewed by one of his associates 50 had tumor thrombi in the main renal veins and in 8 cases the tumor thrombus extended into the vena cava. Beer believes that it may be possible in the future to recognize the existence of such a tumor filled vein before operation by absence of visualization of the pelvis and calices following excretory urography. We do not consider the presence of a tumor

thrombus in the main renal veins a contraindication to nephrectomy if the technic described in Chapter 53 can be followed. We doubt however whether an attempt should be made to operate on cases in which the tumor thrombus extends into the vena cava. The presence of greatly distended veins which are visible on exposure of the fatty capsule is an indication that an attempt has been made to establish a collateral venous circulation owing to blocking of the main renal veins. Such a finding should at once lead to a search for tumor thrombus formation in the veins of the pedicle before any attempt is made to ligate the ureter and mobilize the kidney.

(B) ENLARGED LYMPH NODES OR FATTY CAPSULE. If at operation a number of enlarged lymph nodes are found around the pedicle or there is evidence of involvement of the fatty capsule nephrectomy is contra indicated in our opinion.

End results of Nephrectomy

In the interpretation of the reports of end results it is necessary to remember that only after a lapse of at least five years after nephrectomy can one consider a patient's chances of recurrence as improbable although there are a number of reports of recurrence nine and even eleven years after operation. Another possible source of error in the evaluation of statistics is that unless facilities exist in a clinic for a follow up examination of a very large percentage of operated cases an estimate of the number of even five year cures as compared to the total number of operated patients is of but little value. This latter point is well illustrated by a report of end results from the clinic of Prof. Illyes which appeared recently (*Zeit. Urol. Chir.* 1936 41:123). A questionnaire was sent to 82 patients who had been operated during the preceding six years. Fifty three replies (60 per cent) were received but only 27 patients operated more than five years are of interest here. The high percentage of patients who could not be followed vitiates any deduction which can be made as to the frequency of recurrence as is shown in the following table.

	APPARENTLY WELL	DEAD	NO RESPONSE
13 patients operated five years before	3 = 24%	2 = 15%	8 = 61%
14 patients operated six years before	3 = 18%	2 = 12%	9 = 70%

It is only fair to explain that such a large percentage of failure to respond to the questionnaires is to be ascribed to the fact that many patients who were citizens of Hungary when operated now live in foreign countries where it is difficult to reach them.

Statistics of a somewhat smaller number of cases operated between 1901-32 but all of which could be followed up were reported by Bergendal (*Acta Chir. Scand.* 1936 77:563). Of 94 nephrectomies 1 of 8 embryonal adenocarcinomas is apparently well 12 years and 1 of 3 sarcomas 9 years after operation. Of 76 papillary adenocarcinomas (hypernephroid carcinomas) 40.4 per cent are living 5 years and 30 per cent 10 years after operation.

Walters (*Surg. Gynec. and Obst.* 1933 56:445) reported the end results from the Mayo Clinic. Of 110 cases followed up to 1927 there were 68 who were alive 5-10 years, 22 others more than 10 years, 15 more than 15 years and 5 more than 20 years after nephrectomy. The percentage of 5 year cures was 43 per cent (110 to 256 cases operated from 1901 to Jan. 1, 1927). Of the 110 patients reported well Jan. 1, 1927 only 76 were living in 1932.

The last two reports show that the prognosis of malignant neoplasms, at least for certain types such as the papillary adenocarcinoma (hypernephroid carcinoma) is not as unfavorable as generally thought

The technic and choice of operation will be discussed in Chap 53

PRE-OPERATIVE IRRADIATION OF MALIGNANT RENAL NEOPLASMS

In the discussion of a paper by Munger (Jour Urol, 1937, 37, 680), on this subject, Dean reviewed some of the fundamental factors

Indications Pre-operative irradiation of renal tumors has been recommended (1) to devitalize tumor cells and thereby lessen the likelihood of disseminating metastases by operative manipulations, (2) to diminish the size of the tumor and thus make nephrectomy easier. A large proportion of parenchyma tumors in adults and the majority of Wilms' tumors (embryonal adenosarcomas) in children shrink when irradiated. Only a therapeutic test will determine how much an individual tumor will respond, but the benefit may be so marked that the pre-operative irradiation of all large renal tumors is recommended.

Pre-operative irradiation has also been recommended (3) to make inoperable tumors operable. A tumor is considered inoperable if it has invaded the perirenal tissues or if metastasis has occurred. As yet, irradiation has been unsuccessful in so reducing the tumor in these inoperable cases that nephrectomy will effect a cure. Epithelial tumors of the renal pelvis are radioresistant, hence irradiation is not recommended. At the opposite extreme of radiosensitivity are Wilms' tumors usually composed of embryonal tissues, hence pre-operative irradiation is of the greatest value. Tumors of the renal parenchyma in adults are, in general, of an intermediate radiosensitivity, but there may be considerable differences within the group, hence preoperative irradiation is to be recommended in these cases. Excretory pyelograms and measurement of the tumor are helpful in determining the effects of irradiation.

PERIRENAL AND OTHER RETROPERITONEAL NEOPLASMS

Under this heading can be placed the following groups

- 1 Neoplasms of the fibrous and fatty capsules of the kidney
- 2 Unattached neoplasms of the embryonal urogenital apparatus
- 3 Other retroperitoneal neoplasms (except those of the adrenals)
- 4 Neoplasms of the adrenals

NEOPLASMS OF THE FIBROUS AND FATTY CAPSULES

Benign

Those of the fibrous capsule include fibroma and fibrosarcoma. The most common neoplasms of the peri- and pararenal fatty envelopes of the kidney are the pure and mixed forms of lipoma. Von Wahrendorf (Arch Klin Chir, 1921, 115, 751) reviewed 165 cases, of which 46 per cent were pure and 54 per cent mixed lipomas. Up to 1930, about 200 cases of perirenal lipoma had been reported, according to Crabtree. In 1933, Pemberton and McCaughan added 40 cases observed at The Mayo Clinic. Other rarer benign neoplasms include myoma, myxoma and fibroma.

Malignant

In this subgroup can be placed reported cases of spindle-cell sarcoma liposarcoma angiosarcoma fibromyxosarcoma fibromyxoliposarcoma and of tumors of the same papillary adenocarcinomatous type as are found in the renal parenchyma Lubarsch reported a case of the last named variety in which the tumor had compressed the lower pole of the kidney

UNATTACHED TUMORS OF THE EMBRYONAL UROGENITAL APPARATUS

The occurrence of retroperitoneal neoplasms arising independently of the adult urogenital organs has always eluded scientific explanation according to Hansmann and Budd (Jour Amer Med. Asso 1932 98 6) who have studied 17 cases of unattached retroperitoneal tumors and believe that they arise from remnants of the embryonal urogenital apparatus These authors collected from the literature 40 reports of unattached cystic and 17 of unattached solid tumors and added 17 personal observations of which 3 were cystic and 14 solid. Of their own cases 9 had their origin in sex cells, 4 in mesonephric cells, 1 in cells of the müllerian duct and 3 were of unknown origin.

The cystic tumors may be simply lined by epithelium or they may also contain hair and immature hair follicles. The capsule is usually quite thick and adhesions may be present which render enucleation difficult The thickness of the wall and the brownish, grumous content should lead one to suspect a preformed cyst rather than a chronic abscess at operation. Hair in the cyst content renders the diagnosis sure Dermoid teratomas are similar except that they contain multiple cysts with many well defined hair follicles. The content of the cysts in addition to being grumous is greasy Hair is usually abundant and coarse Shadows resembling those of bone or cartilage on the plain film are very suggestive of retroperitoneal dermoid In Campbell's case (Jour Urol, 1933 29 577) a ring shaped shadow of calcium density led to the suspicion preoperatively of the presence of a dermoid cyst in an infant six months old. Only five similar cases have been reported

OTHER UNATTACHED CYSTIC TUMORS of the embryonal urogenital apparatus are cystadenomata and cysts in the walls of which remnants of tubules and glomeruli are found indicating mesonephric origin.

The solid tumors are found as chorionepithelioma alveolar and adenocarcinoma leiomyoma somewhat more malignant than those of the adult uterus fibrosarcoma leiomyosarcoma rhabdomyosarcoma adenosarcoma, endometrioma and round cell sarcoma.

OTHER RETROPERITONEAL NEOPLASMS

Tumors of the adrenals are excepted

In this group can be placed the following

(a) Malignant lymphoma (Fig 563) or lymphoblastoma, which includes (Chute Jour Amer Med Asso 1931 97 969) Hodgkin's disease or lymphogranuloma, lymphoendothelioma lymphosarcoma and the infiltrations seen in lymphatic leukemia.

(b) Cases of Retroperitoneal Perirenal Lymphangioma. Kretschmer and Hibbs (Arch. Surg 1934 29 113) reported a case and were able to find four other reports

(c) Cases of other types of retroperitoneal sarcoma than those mentioned under (a), such as round or spindle-cell sarcoma

The symptoms of retroperitoneal neoplasms, with the exception of the adrenal syndromes, are (a) those due to displacement of adjacent structures and (b) the appearance of an enlargement in the right or left upper quadrant of the abdomen

Diagnosis In retroperitoneal tumors, which are not of adrenal origin, the diagnosis is one of exclusion from intrarenal and all other varieties of abdominal

FIG 564

FIG 563



FIG 563—Displacement outwards of kidney and ureter with marked urographic deformity due to retroperitoneal malignant lymphoma (see text) (Cook County Hospital case)

FIG 564—Marked displacement of ureter mesially with resultant urographic deformity in a case of retroperitoneal sarcoma in an adult (Mt Sinai Hospital case)

tumors referred to earlier in this chapter. The presence of a mass in one of the upper abdominal quadrants is of much diagnostic value, but it is not always present. In the 40 cases of perirenal lipoma reported by Pemberton and McCaughan (loc cit) a mass was the first sign in 28 cases. In some patients, a diagnosis is impossible until symptoms of pressure (kidney or gastrointestinal) call attention to the necessity of a urologic examination.

A complete urologic examination should be a routine procedure in all cases of abdominal tumor of doubtful origin. The following changes in the location of the ureter are of diagnostic value in the diagnosis of perirenal and other retroperitoneal neoplasms:

Displacements inwards (Fig 564) or outwards of the ureter (Fig 563)

Displacement or rotation of the kidney (Fig 566)

In some cases no such displacements may be present.

Recently, Cahill (Jour Urol, 1935, 34 238) has employed pneumoradiography (perirenal insufflation) to outline the size of the adrenals (Fig 567) with a modified Carelli technic. Mencher (Jour Amer Med. Asso, 1937, 109, 1338) has used perirenal insufflations in ten cases in three of which the films were positive for adrenal lesions.

NEOPLASMS OF THE ADRENALS

The cortical tumors include adenoma carcinoma and melanoma (seldom primary)

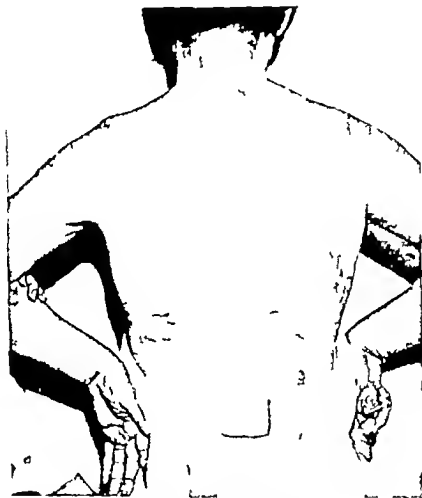


FIG. 565—Hirsutism of trunk as observed in case of adrenal neoplasm in female patient. (Michael Reese Hospital case)

The adenoma varies in size from a few mm to 10-12 cm. and is well encapsulated. Both the gross and histological picture is that of the adrenal cortex. Carcinoma is the most malignant neoplasm of the cortex. According to Kaufmann it is neither a carcinoma or sarcoma but the former term is usually employed. Extension to the kidney and to other adjacent structures is very common followed by general metastasis.

Types. Neoplasms of the adrenal medulla are placed in four groups according to the embryological element involved

- 1 THE SYMPATHOGONIOMA (neuroblastoma) arises from very immature cells—are all congenital and found mostly in infants under one year of age
- 2 THE NEUROCYTOMA arises from slightly more differentiated cells

3 THE GANGLIONEUROMA arises from highly differentiated ganglion cells and is rarely found within the adrenal

4 THE PARAGANGLIOMA consists of fully developed chromaffin cells. They are very rare

The symptoms vary according to the sex and age of the patient

FETAL If the neoplasm has developed during fetal life, the outstanding features of the clinical picture are (a) pseudohermaphroditism (Fig 235), (b) virilism, (c) masculinism and (d) hypertrichosis

PREPUBERTAL If the neoplasm develops during early postnatal life, the outstanding features of the clinical pictures are (a) sexual precocity (hypertrophy of penis) in both boys and girls (hypertrophy of clitoris) and (b) heterosexual physical characteristics such as deep voice, lack of development of breasts, narrow hips, hypertrichosis, obesity in girls

POSTPUBERTAL If the neoplasm develops after puberty, the outstanding features of the clinical picture are the following

(a) Decreased menstrual flow or complete cessation (amenorrhea)

(b) The trunk, neck and face, especially around angle of jaw, are unusually obese

(c) The hair of the scalp becomes coarse and falls out

(d) Coarse hairs (Fig 565) appear all over the body, but especially over the legs and face

The above cortical neoplasm syndrome resembles greatly that due to a basophil adenoma of the pituitary gland as described by Cushing. The chief differences, according to Jacobziner and Garfinkel, are

	NEOPLASMS OF ADRENAL CORTEX	BASOPHIL ADENOMA OF PITUITARY GLAND
Age at onset	Young children and adolescents	Adolescents and adults
Adiposity	Generalized, present in 50 per cent	Always present, limited to face, neck and trunk
Hypertrophy of external genitalia	Marked hypertrophy of penis in boys and of clitoris in girls	Moderate hypertrophy of clitoris, atrophy of penis
Hypertrichosis	Always present, pubic hair very early	Commonly present, especially on face and trunk
Pseudohermaphroditism	In females only	None
Menstruation	Amenorrhea if develops after puberty	Same
Roentgenogram of skull	No changes	Decalcification and osteoporosis
Sella turcica	Normal	May be enlarged
Sex incidence	More common in females	Equal in both sexes
Sugar tolerance	Normal	Lowered
Blood pressure	Normal	Hypertension
Basal metabolism	Normal	Low

SYMPTOMS OF DYSFUNCTION OF THE MEDULLARY PORTION

HYPERACTIVITY OF THE MEDULLARY PORTION of the adrenal is characterized by

(a) Recurrent attacks of precordial distress, occipital headache, generalized pallor, cold clammy skin, choking sensation, followed by nausea and vomiting

(b) Hypertension

HYPOACTIVITY is characterized by symptoms resembling those of Addison's disease, such as, asthenia, low blood pressure, pigmentation of the skin

Diagnosis Langeron and Loheac, quoted by Cahill (Surg Gynec and Obst, 1936, 62, 287), state that cortical neoplasms present clinically as

(a) Those with endocrine symptoms alone

(b) Those with only an abdominal mass

(c) Those with metastatic masses.

(d) Those with arterial hypertension either paroxysmal or continuous

In cases in which the presence of an adrenal neoplasm appears probable the diagnosis can be made by comparing the clinical picture with the above cited syndromes and by palpation and urography Player (Urol and Cut Rev 1933, 37 758) made a pre-operative diagnosis of left adrenal cortical tumor by noting a compression of the upper calices in the urogram of the corresponding kidney. The clinical picture in a boy almost five years old was that of marked sexual precocity. The diagnosis was verified at operation.



FIG. 566.—Displacement of the right kidney downwards by an adrenal (right) neoplasm (Michael Reese Hospital case)

A recent personal case in which the diagnosis of adenoma of the adrenal cortex was verified by operation illustrates the value of interpretation (a) of the evidences of dysfunction of the adrenal cortex and (b) of the results of the urological examination. The patient, an adult female, presented a marked hypertrichosis (hirsutism) of the back of the neck and trunk as shown in Fig 565. Bilateral urography revealed (Fig 566) a marked displacement downwards and outwards of the right kidney. A plain film following perirenal insufflation of carbon dioxide showed (Fig 567) an oblong white area over the eleventh and twelfth ribs on the right side. Palpation of the right upper abdominal quadrant was negative.

Treatment of Adrenal Cortical Neoplasms. The removal of an adenoma of the adrenal cortex offers the only chance of amelioration of the clinical syndrome in adults. In children the correction by plastics of the co-existing false pseudohermaphroditism constitutes a second step in the operative treatment.

Young (Monograph on Genital Abnormalities etc., 1937, Williams and Wilkins Co.) has found 24 reports of adrenalectomy, all in females, for neoplasm of the adrenal cortex. There are reports of 31 cases of adrenal neoplasm in children, 26 females and 5 males. Thirteen female patients were operated

CONDITION OF OPPOSITE ADRENAL IMPORTANT

The importance of a knowledge of the condition of the opposite adrenal is exemplified by the recently (Jour Urol, 1938, 39, 81) reported case of Scholl

At operation, the right adrenal was found imbedded in fat, from which it could not be easily freed. No tumor masses were felt. A rounded, nonadherent

mass, about 4 cm in diameter, which proved on histologic study to be an adenoma, was found in the left adrenal. In addition to the typical adiposo-genital syndrome (previously described in this chapter) the outstanding clinical feature had been a systolic pressure of 208 mm which rose to 230 mm at the time of starting the operation. Following the latter, the blood pressure dropped rapidly. The patient failed to survive the profound postoperative shock.

At necropsy, a marked atrophy of both adrenals was found, more evident however on the right side.

In a large number of cases reported in the literature, the opposite adrenal was either absent or, as in Scholl's case, inadequate to support life as the result of atrophy.

Technic for Simultaneous Exposure of Adrenals Young (loc cit) has described a technic for simultaneous exposure and study of the adrenals, the patient being placed face downwards with a pad beneath the chest and another beneath the pelvis and lower extremities. Bilateral incisions are made on each side of the median line, two surgeons operating simultaneously. The respective incisions begin 5.5 cm from the median line and are directed downward and outward to a point 8 cm from the median line to the chest of the ilium. The costovertebral ligament (see Chapter 53) is divided after division of the latissimus dorsi. An excellent exposure of Gerota's fascia on both sides is obtained. By retracting the respective kidney downward and outward, both adrenals are completely exposed, with the aid of a special double retractor. By inspection and palpation, the operator is able to determine whether a simple hyperplasia (see Chapter 45 on Urology in the Female) or a neoplasm of the adrenal cortex is responsible for the clinical picture.



FIG 567—Right adrenal neoplasm (oblong white area over eleventh and twelfth ribs) outlined by perineal insufflation of 550 cc of carbon dioxide (Michael Reese Hospital case)

CHAPTER 44

NEPHRITIS*

INCIDENCE
CLASSIFICATION
ALBUMINURIA
URÆMIA
KIDNEY OF TOXÆMIA OF PREGNANCY
FOCAL GLOMERULONEPHRITIS
TOXIC NEPHRITIS OR NEPHROSIS

ACUTE DIFFUSE GLOMERULONEPHRITIS
SUBACUTE NEPHRITIS WITH EDEMA
CHRONIC NEPHRITIS WITH EDEMA
CHRONIC NEPHRITIS WITHOUT EDEMA
RENAL RICKETS
ARTERIOSCLEROTIC BRIGHT'S DISEASE
SURGERY OF NEPHRITIS

The various forms of Bright's disease are included under this term. Nephritis is characterized by inflammatory, proliferative and degenerative changes not due to direct bacterial invasion. Arteriosclerotic Bright's disease is associated with hypertension and is usually an end stage of essential hypertension. Nephritis is in most cases a diffuse lesion involving both kidneys and producing changes in the parenchyma, interstitial tissues and renal vascular areas. Focal nephritis, involving limited portions of one kidney, also occurs. In acute nephritis the inflammatory changes are usually seen, but as the nephritis becomes more chronic progressive degenerative changes are characteristic.

INCIDENCE

Chronic nephritis ranks high among the causes of death, coming third or fourth in most statistics. (Christian.) Chronic nephritis is a frequent cause of disability and individuals suffering with it constitute a large percentage of medical patients.

CLASSIFICATION

None of the classifications of this disease are entirely satisfactory. The more recent classifications have attempted to correlate the clinical and pathologic findings. The best of these are the classifications of Volhard and Fahr, that of Addis, and that of Christian. The classification of Volhard and Fahr is as follows:

- 1 Inflammatory Nephritides
 - a. Focal nephritides
 - Focal glomerulonephritis
 - Septic interstitial focal nephritis
 - Embolic focal nephritis
 - b. Diffuse glomerulonephritis
 - 2 Degenerative Nephroses
 - a. With amyloid degeneration of the vessels
 - b. Without amyloid degeneration of the vessels
 - c. Necrotizing nephroses
 - 3 Arteriosclerotic Renal Disease
 - a. Benign hypertension
 - b. The combination form of sclerosis plus nephritis
- Addis in 1931 divided nephritis into

* We are indebted to Dr. R. I. Lurie for valuable assistance in the preparation of this chapter.

- 1 Hemorrhagic Bright's disease, which includes all inflammatory nephritides
- 2 Degenerative Bright's Disease
- 3 Arteriosclerotic Bright's Disease

The classification by Christian, with slight modifications, is satisfactory for clinical purposes

Acute Nephritis

Subacute nephritis—with edema—hemorrhagic nephritis

Chronic nephritis—with edema—without edema

Hypertension and the kidney of malignant hypertension

Arteriosclerotic Senile Kidney

ALBUMINURIA

When albumen is found in the urine it is usually an indication of organic renal disease. However, the albumen may be extrarenal in origin due to the presence of considerable pus in the urine. We have mentioned vesicular albuminuria in the chapter on seminal vesiculitis. The secretions of the prostate and seminal vesicles which contain serum globulin may escape into the urethra and become intimately mixed with the urine. Some cases of albuminuria in adolescent boys are, in fact, globulinuria.

Functional Albuminuria. Functional albuminuria is most frequently noted in adolescence and is usually transitory. Transitory albuminuria may follow severe exertion. The extent to which albuminuria may occur in supposedly healthy young adults has been a subject of much discussion.

The studies of Dublin and those of Addis are widely quoted. Diehl and McKinlay have recently reported their findings among 16,748 freshmen, average age about nineteen, at the University of Minnesota, 5.24 per cent had albuminuria as determined by a single specimen using the nitric acid ring test. Subsequent examinations of 460 of these students who had albuminuria on the first examination showed that in 68 per cent the albuminuria was transient.

Orthostatic Albuminuria. The interpretation of so-called orthostatic albuminuria is sometimes difficult. The rapid appearance of albumen in considerable amounts in the urine after the patient has been in the upright position, and its disappearance when in the prone position, is the phenomenon known as orthostatic albuminuria. The albumen is usually most abundant during the first two hours after rising. Many are of the opinion that the albuminuria is due to a lordosis and that when the lordosis is corrected there is no further albuminuria in most cases. The condition usually occurs in youths between the ages of nine and sixteen, is most frequently seen in children who are growing rapidly, and in most cases clears up after adolescence. In some cases functional albuminuria persists and develops later into true nephritis.

Febrile Albuminuria. In patients suffering with febrile diseases, albuminuria is frequently noted. It usually clears up after the temperature has fallen and with the subsidence of the acute process. Many clinicians are of the opinion that febrile albuminuria is in most cases a mild attack of acute glomerulonephritis. Sections of kidneys of patients dying of pneumonia, typhoid and other

acute infectious diseases show inflammatory and degenerative changes in the glomerular endothelium

UREMIA

Uremia is an intoxication induced by renal insufficiency (Christian) The majority of cases occur as a complication of nephritis, but uremia may be the sequel of urinary suppression from other causes as in renal calculi or prostatic obstruction The causation of uremia is not well understood Anuria in man and bilateral nephrectomy in the experimental animal result in death but the clinical picture is not similar to that seen in uremia due to chronic renal insufficiency

The symptoms of uremia fall into three main groups toxic psychic and neuromotor Toxic symptoms are headache lethargy and gastro-intestinal disturbances. Psychic disorders range from a mild delirium with hallucinations to stupor and coma Epileptiform convulsions are the most striking feature of the neuromotor manifestations.

The symptoms may also be divided into cerebral gastro-intestinal and respiratory The cerebral type of uremia is the one most frequently seen in acute nephritis and consists of severe headache and convulsions The gastro-intestinal manifestations are usually seen in chronic nephritis and are manifested by nausea vomiting and diarrhea. The respiratory symptoms appear late with paroxysmal dyspnea and attacks of orthopnea with an occasional hissing type of respiration

CHRONIC Some patients suffer with chronic uremia. The symptoms are progressive but usually persist for many months often without any apparent change The skin becomes dry the patient has no desire for food the tongue becomes dry hemorrhages occur in the mucous membranes and the characteristic urinous odor to the breath develops later The evidence in the blood is the gradually increasing retention of the nitrogenous end products Changes in the retina may also occur with hemorrhage, exudates with edema Albuminuric retinitis and vascular changes in the retina are found

The urologist must frequently deal with chronic uremia as a result of chronic urinary retention secondary to bladder neck obstruction Prolonged drainage of the bladder preferably suprapubic, will frequently relieve the patient of his uremia and improve his condition so that prostatectomy can be done successfully later Urosepsis is the term given in the older urologic literature to renal insufficiency associated with or due to chronic renal infection This is the condition frequently noted in prostatic hypertrophy and in later stages of calculous disease of the kidneys These patients have a cloudy urine there is a constant low grade fever some renal infection is present and sub-uremic symptoms dominate the picture Patients dying of carcinoma of the prostate frequently have uremic manifestations due to ureteral obstruction Uremia usually occurs as a terminal stage of polycystic disease of the kidneys

THE KIDNEY OF TOXEMIA OF PREGNANCY

A slight degree of albuminuria is not inconsistent with a normal pregnancy It usually clears up after the termination of pregnancy When albuminuria during pregnancy is associated with a hypertension which is gradually increasing it is due

to some degenerative changes in the kidney These patients must be carefully observed for this condition may terminate in eclampsia

FOCAL GLOMERULONEPHRITIS

This condition is usually found in association with a streptococcus infection, in the throat Angina and tonsillitis are the most common sources Gross hematuria, which is transient, together with hyaline and granular casts make up the urinary findings The so-called essential hematuria is in most cases due to a localized glomerulonephritis which usually clears up and may recur It is not uncommon to see patients with attacks of hematuria and colic who present negative findings on cystoscopy and pyelography Although some of these may be due to radiotranslucent calculi, it is our opinion that an appreciable number are due to an acute focal glomerulonephritis which clears up rapidly

In subacute bacterial endocarditis, emboli to the kidneys will be evidenced by acute renal pain and hematuria

TOXIC NEPHRITIS OR NEPHROSIS

Acute poisoning with heavy metals such as mercury, lead and arsenic may produce marked renal insufficiency Bichloride of mercury and methyl alcohol are also frequent causes of toxic nephroses The changes produced are often very marked and diffuse throughout the kidneys The tubular system however is the one chiefly affected Treatment consists of washing the stomach and antidotes by mouth When the renal damage is severe, surgery in the form of decapsulation and nephrotomy may be indicated

ACUTE DIFFUSE GLOMERULONEPHRITIS

This is the acute, hemorrhagic nephritis in which the glomeruli are particularly involved and the pathologic changes are chiefly inflammatory Mild forms, occurring in contagious hospitals, and following surgical wounds, are frequently overlooked Its incidence is probably greater than the usual statistical data tends to indicate

Etiology The primary and essential cause of acute glomerulonephritis is infection The relationship in children between acute glomerulonephritis and foci of infection is well established Infections of the upper respiratory tract are the most frequent source Sinus infections and tonsillitis are frequently associated Many of these children have a chronic otitis media and evidence of involvement of the mastoids Scarlet fever is frequently followed by acute glomerulonephritis Its incidence and severity vary considerably in different epidemics

Streptococci are the most frequent organisms All varieties of streptococci have been found in the blood in acute nephritis The bacteria are, however, not present in the kidney—neither are they found in the urine It is evident that bacterial toxins rather than the bacteria themselves are the cause of the nephritis Acute glomerulonephritis is most common in childhood Boys are somewhat more frequently affected than girls Exposure to cold and chilling is an important predisposing cause

Pathology The kidney of acute nephritis is larger than normal the appearance is rather moist and there may be edema or hemorrhage. The color varies from pale gray to yellow gray and to mottled gray and red. Sometimes the glomeruli may be seen as bright red points. Microscopically glomerular lesions are invariably present. The type of lesion varies from a small amount of exudation in the capsule to a complete hemorrhagic destruction. Acute inflammatory lesions are seen in the glomeruli, together with progressive changes in the epithelial elements. Degenerative changes are usually rare.

Symptoms. The interval elapsing between the onset of the preceding infection and the beginning of renal symptoms varies with the type of infection. Nephritis following angina usually appears about ten days after the onset of the angina. In scarlet fever the time of onset of the nephritis varies considerably with the epidemic. It usually occurs during convalescence, appearing on an average between fifteen to twenty days following the appearance of the eruption.

THE SUBJECTIVE CLINICAL SYMPTOMS are headache, vomiting, visual disturbances, convulsions and coma. Objectively edema, oliguria with gross hematuria and albuminuria are noted together with elevation of blood pressure. Edema may be the first objective symptom and usually involves the face first. It may then become diffuse with large accumulations of fluid in the serous cavities causing pleural effusion or ascites. Examination of the eye grounds during the acute stage may show some edema of the disks. The urine is usually acid in reaction and appears smoky or brown. The typical smoky urine of acute nephritis. Microscopically the urine is full of epithelial elements, red cells, leukocytes, and all varieties of casts. Albumen is usually present in large amounts. The excretion of urea is diminished and there is a decrease in chloride excretion in the presence of edema. The blood shows but slight increase in the retention of non-protein nitrogen. There is a marked decline in the red cell count which usually appears after the first two to three weeks of the disease.

Clinical Course The subsequent course of the disease is not affected by the severity of the initial attack. The acute stage may continue for a number of weeks and result in recovery with surprisingly little subsequent evidence of damage. If the hypertension becomes marked the heart rate becomes rapidly accelerated and the possibility of convulsive seizures must be born in mind. In children this is much more common than in older persons. The edema may subside rapidly in favorable cases and complete recovery is frequently seen. In unfavorable cases hematuria will persist, a marked anemia develops and uremia terminates the picture. Recovery is the rule and the fever subsides within two to four weeks. The edema and hematuria may persist for a few months before completely subsiding. In a small proportion of cases there is a certain degree of improvement and then the nephritis persists and later becomes chronic.

Treatment. Acute nephritis should be regarded as a general disease such as pneumonia. Once healing occurs the patient recovers completely in the majority of cases. As stated previously a relatively small percentage fail to recover and develop chronic nephritis. There is no specific therapy for nephritis. The most important feature is rest in bed for a prolonged period. The remainder of the therapy is strictly supportive. Foci should be removed as soon as the acute symptoms have subsided. This is important for there may be recurrences or the condition may become chronic unless the foci are removed.

Many clinicians limit fluids to a daily intake of 1200 cc or less on the premise of resting the kidneys. Others believe that since nephritis in the acute stage is a generalized disease, with evidences of toxemia and a moderate acidosis, that the condition should be treated as is pneumonia, and that fluids should be forced.

Diuretics are contraindicated in acute glomerulonephritis. Catharsis is, however, necessary. In giving cathartics, it is best to avoid salts that will be utilizable by the body. Magnesium sulfate, magnesium citrate, and sodium sulfate are the most widely used. Sodium chloride should be avoided, but a completely salt-free diet is non-palatable. A salt poor diet containing about three grams of sodium salt daily is satisfactory. A simple nutritious diet can be given in most cases, with a protein sufficiency to allow for metabolism and for the loss of proteins through the albuminuria.

TREATMENT OF CEREBRAL EDEMA WITH UREMIC-LIKE SYNDROME In many cases of acute glomerulonephritis, the patient may suddenly develop headaches, together with a sudden rise in blood pressure. These are signs of a wet brain with increased intracranial pressure. There is a marked retention of nitrogenous products, and the patient is termed uremic. This is not a true uremia, for it responds rapidly to drastic dehydration with concentrated solutions of magnesium sulfate, which can be given orally, intramuscularly and even intravenously.

SUBACUTE NEPHRITIS WITH EDEMA

In this grouping (nephrosis syndrome) are included the cases in which the pathology, the duration and the manifestations are intermediate between acute and chronic nephritis. The term subacute carries an indefinite meaning as to time. In one patient this stage may be reached after a lapse of a few weeks, while in others a lapse of months may occur and the transition from an early to a more advanced stage may be so gradual as to escape recognition. The use of the term second stage seems more accurate. Subacute nephritis with edema corresponds to the nephroses of many authors.

As with acute nephritis, the main etiological factor in subacute glomerulonephritis is infection. Here the relationship between infectious diseases or foci is not so definite. The severity of an acute attack by no means indicates that the condition will become subacute or chronic. Most cases develop without any definite previous history of acute infection. Subacute glomerulonephritis occurs in all ages, but is more common from the ages of eleven to thirty-five. Many cases of glomerulonephritis reach the subacute as well as chronic stage without showing any etiological factor for the disease.

Pathology

GROSSLY, the kidney of the second stage has been described as a "large white kidney." Occasionally, when the disease has been of longer duration, the kidneys may even be slightly smaller than normal. The capsule is usually loose, and the surface smooth, pale gray, mottled red, or yellow. Usually the kidney shows extensive glomerular changes. On section, the cortex appears swollen, with occasional hemorrhagic dots, the pyramids are usually reddened in contrast to the glomerular paleness.

MICROSCOPICALLY, the changes are those of degeneration with subsequent atrophy. Hyalinization of the glomeruli with marked tubular changes, together

with some proliferation of interstitial tissue is seen. Capsular thickening with epithelial crescents is fairly prominent.

Symptoms. The edema which in the later stages often includes an ascites or a hydrothorax is the prominent feature of the disease. It is associated with a paleness or a pastiness which is usually but not always an evidence of marked anemia. There is as a rule no rise in blood pressure. Subjective symptoms as head ache, anorexia and gastric disturbances are present but not marked. The blood shows little or no non protein nitrogen retention. There is a definitely lowered plasma protein with a reversal of the albumen globulin ratio. The cholesterol may be high and the blood chloride is usually very high. The urine is decreased in amount with an increased specific gravity. Albumen in the urine is very prominent and microscopic examination shows many leukocytes, many casts of all types including fatty and in fatal cases the large renal failure casts described by Addis will be seen. Red blood cells will be found but are not common. Renal function tests usually show little if any impairment but in fatal cases there is a rapid decrease in renal function. Toxic symptoms are rare, weakness is common and intercurrent infections are extremely common and dangerous. A pneumococcic peritonitis is frequently the terminating disease.

Diagnosis. This can usually be made without difficulty. The edema with the blood and urinary findings is characteristic. Differentiation must occasionally be made between cardiac failure with generalized edema and occasionally from diffuse angioneurotic edema and the edema of starvation.

The prognosis in these cases is very poor. Death usually results from an intercurrent infection. As stated previously pneumococcic peritonitis frequently occurs for the pneumococci find the ascites a very favorable medium for propagation. Others may recover from the edema and then die later of a chronic nephritis. There have been a few reports of patients who have recovered.

Treatment. Except for the very rare cases of luetic etiology which should be given anti luetic therapy treatment is essentially directed toward the relief of the edema. There is no general agreement as to the amount of fluid intake. The diet should be one of high caloric value with a high protein content. Diuretics are particularly indicated and cathartics should be frequently used. Blood transfusions are often very beneficial and may be given at short intervals. The basal metabolic rate is frequently low. Thyroid extract is frequently administered to maintain a normal body metabolism. Vitamins are often given freely for there are many clinicians who are of the opinion that there is a considerable vitamin deficiency in this disease.

CHRONIC NEPHRITIS WITH EDEMA

An appreciable number of these cases are merely a further stage of subacute nephritis with edema. In this grouping are included a large number of cases of chronic hemorrhagic nephritides that develop edema during the course of the disease. The cases that were formerly described as nephroses in which the main differentiation made from a predominantly glomerular type of nephritis was the presence or absence of hematuria are also included here. Lastly the amyloid type of kidney is included. This type of degenerative kidney disease follows prolonged severe infection such as chronic empyema or a chronic osteomyelitis.

The course of this disease is essentially similar to that of subacute nephritis with edema, except that it is more gradual in development, the edema is more insidious, and the urine shows less albumen. It is important to stress the fact that one cannot usually follow a case of nephritis from the acute into the subacute and then into the chronic stage. The subacute nephritis does not often progress into the chronic stage before the patient dies. The majority of cases when first seen are already in the chronic stage. This does not hold true for the uncommon case which fits the description of a Pel-Epstein type of nephrosis, which is usually first seen in the acute stage, with an associated tremendous edema.

Etiology In most cases of chronic nephritis, whether with or without edema, the cause is not evident. Infection is the most important single etiologic



FIG. 568—Edema of penis and scrotum in nephritis

factor. A low grade nephritis is initiated by many subclinical attacks from some focus of infection. It is usually not recognized until the chronic stage is reached. In the lipid type of nephritis, syphilis may occasionally be an etiologic factor, but in most cases no specific cause has been proven responsible. In the amyloid type, there is a definite association with chronic infectious processes, as osteomyelitis, tuberculosis, empyema, and bronchiectasis. In these cases the kidney is not alone involved, but is merely part of a generalized amyloidosis. Amyloidosis has also been reported with other forms of chronic disease such as carcinoma, and Hodgkin's disease.

Pathology Changes in chronic nephritis involve all elements of the kidney. The differences in type are due to a larger involvement of one element with a lesser involvement of the others. Thus, the glomeruli, the tubules, the blood vessels and interstitial tissue show some changes. The kidneys are usually smaller than normal in spite of the presence of edema. The gross appearance is rather pale with only moderate to slight granulation. The capsule strips with difficulty, and on section the cortex is definitely thinned, with a moderate to large degree of pyramidal tract destruction. Many glomeruli are hyalinized and the tubules associated with these glomeruli are either shrunken cords or have disappeared. The interstitial tissue shows scarring, but the apparent increase is mainly relative.

The lipid kidney is not a contracted kidney. The kidneys may actually be larger than normal and are usually pale grey. The capsule strips with moderate ease, and upon section the cortex is yellow and appears thickened and the pyramids may be slightly swollen. Microscopically the changes are mainly tubular. The glomeruli have in all cases shown slight changes. This is the lipid nephrosis of many authors.

Symptoms and Clinical Course Edema is the most prominent symptom and may be very marked with anasarca and extensive swelling of the genitalia. When the edema involves the eyelids, it is most marked in the morning, and

clears up considerably by evening. Anemia is also present. Marked gastrointestinal disturbances, and weakness are noted. The prognosis is very poor. Uremia is infrequent, death being usually due to a progression of the nephritis, or an intercurrent infection. In many patients the edema gradually disappears and the condition then shifts to a chronic nephritis without edema.

CHRONIC NEPHRITIS WITHOUT EDEMA

CHRONIC INTERSTITIAL NEPHRITIS

This is by far the most frequent form of chronic Bright's disease. No definite causative agent has been found. Metabolic disturbances and exogenous toxins are probable predisposing causes in some cases.

Pathology. The kidney is small, granular, with an adherent capsule and a thickened cortex. There is a marked increase in connective tissue. The glomeruli are largely atrophic, and the blood vessels show thickening and narrowing of the lumen. This type of kidney can be readily recognized from the gross specimen. The heart usually shows a marked hypertrophy of the left ventricle, and there is some evidence of generalized arteriosclerosis.

Symptoms. These vary considerably and are due to the renal insufficiency together with the hypertension and cardiac embarrassment. They are gradual in onset with steady progression. The disease may last for many years before the patient dies. In some cases, however, the progress is rapid; six to nine months may cover the entire period of the disease. Patients suffering from chronic nephritis do not recover.

These patients present a variety of symptoms. These are due to the toxemia as a result of renal insufficiency and are also caused by the associated hypertension. The blood pressure becomes markedly elevated. Hemorrhages on the surface and in deeper structures are frequently noted. Hematuria is not a rare incident in chronic nephritis.

Changes in the eye grounds are common. They are manifested by irregularity and torsion of the vessels and retinal hemorrhages.

The urine is pale. Of low specific gravity. Is increased in quantity and contains a small amount of or no albumen, with a few casts. The concentration and dilution test shows a marked disturbance in renal function. The specific gravity shows but little variation and is almost fixed.

Uremia is frequent. This is the type of nephritis in which it most frequently occurs. Sudden vascular accidents are common.

Treatment. Drug therapy is of little avail except symptomatically to promote sleep or relieve nervousness. It is necessary to combat the anemia and give supportive treatment to the heart when necessary.

Diet. In the stationary stage of chronic nephritis dietary management is important. The diet recommended is essentially a normal diet, high in vitamins, restricting but not forbidding salt and allowing meat once daily. A salt free diet is extremely difficult to maintain because of the tastelessness of the food. If a diet poor in salt is recommended the patient will still consume approximately 3 Gm. of salt daily whereas about 6 Gm. are consumed in the normal daily diet. Proteins are not spared. Frequently a diet large in all vitamin elements will exert

a seemingly favorable effect Alcohol, tea, coffee, and tobacco are forbidden Water is given as tolerated, neither restricted nor urged

CLIMATE A change of climate to a dry, warm area is urged These patients do not tolerate a cold, wet climate

RENAL RICKETS

This type of chronic nephritis is peculiar to infants and adolescents There is a retarded growth, with a retarded development of all organs of the body, and bony changes The changes in the kidney are those of chronic interstitial nephritis Bone pathology is typical of that of rickets Genu valgum or knock knee is the most typical manifestation The bony changes are due to failure to excrete phosphorus The concentration of phosphorus in the bowel interferes with calcium absorption from the food, thus leaving a calcium deficiency, and rickets These patients as a rule do not survive much beyond puberty This condition must be differentiated from renal insufficiency due to hydronephrosis and polycystic disease of the kidneys, both of which may present the picture of infantilism

ARTERIOSCLEROTIC BRIGHT'S DISEASE

Benign and malignant nephrosclerosis and the senile arteriosclerotic kidney are included under this term

MALIGNANT NEPHROSCLEROSIS

This condition is an end stage of essential hypertension Individuals suffering with essential hypertension die either of cardiac failure or cerebral hemorrhage or uremia In over 90 per cent of cases of essential hypertension, there is no impairment of renal function for a long time

Nephrosclerosis is characterized pathologically by marked changes in the vascular tree of the kidney In the benign type of nephrosclerosis, the process is slower in development and does not present the rapidly fatal clinical picture of malignant hypertension

The arteries show the all important lesions of this disease In benign nephrosclerosis, there is a thickening of the subendothelial layer, and a narrowing of the lumen of the afferent arteriole and the interlobular arteries Ischemia develops, which results in degenerative changes in the glomeruli and tubules, so that the process may vary but little from that of chronic glomerulonephritis

In malignant nephrosclerosis the degenerative changes are rapid and marked The gross appearance of the kidney is characteristic It is granular, with hemorrhages on its surface and breaks apart on pressure The changes in the kidney develop very rapidly, with necrotic areas in the arterioles and hemorrhages into the surrounding tissues Endarteritis obliterans is also pronounced in the arterioles Arteriolonecrosis describes this condition properly

Essential hypertension is usually a hereditary disease, with a history of deaths from vascular accidents at a relatively early age among various members of the family It is not incompatible with good health, so that these patients with malignant hypertension do not show evidence of renal insufficiency until the kidney becomes affected

From then on the clinical course of malignant nephrosclerosis shows a rapid progression and the patient will die within a few months of uremia or an intercurrent vascular accident or pneumonia

These patients have a high systolic pressure but the particular characteristic of this disease is a high diastolic pressure. Readings of systolic pressures of over 250 and diastolic of 150 are not uncommon. A relatively high diastolic pressure in an individual with hypertension is ominous of progressive generalized arteriolar changes which frequently localize in the kidney

BENIGN NEPHROSCLEROSIS

In benign nephrosclerosis the pathologic changes are not as marked nor as rapid in progression. The picture is similar to that of chronic degenerative Bright's disease with gradual progression over a period of years

THE SENILE ARTERIOSCLEROTIC KIDNEY

This is part of a generalized vascular deterioration with tissue atrophy. The systolic pressure is slightly elevated but the diastolic pressure remains normal. These patients do not as a rule succumb of renal insufficiency. Uremia does not develop

SURGERY OF NEPHRITIS

REMOVAL OF FOCI OF INFECTION

This is important in acute nephritis. When the symptoms of acute nephritis have subsided, removal of infected tonsils and clearing up of infected sinuses and discharging ears will in many cases, prevent further attacks. All other sources of infection should be eradicated. When subacute nephritis has developed removal of distant foci when present may help. In isolated instances only. Subacute and chronic nephritis if the result of focal infection have developed through repeated reinfection from these foci. Removal of any foci in chronic degenerative disease of the kidney will rarely have any effect on the course of the already fully developed nephritis

The surgical measures directed to the kidney one or more of which may be indicated in the individual case are as follows

- 1 Decapsulation
- 2 Nephrectomy
- 3 Nephrotomy
- 4 Denervation
- 5 Splanchnic sympathectomy and rhizotomy with partial adrenalectomy and adrenal denervation

1 Decapsulation is the operation most frequently resorted to, and offers three important avenues through which in properly selected cases great benefit is obtained

a. Release of intrarenal tension or decompression—which is an immediate effect but does not have a permanent effect because as has been shown the fibrous capsule reforms and may again compress the kidney parenchyma.

b. Partial denervation incident to stripping the capsule through which some of the sympathetic fibers reach the kidney

c Aseptic protein shock—as a result of the liberation and absorption of fluid from the decapsulated kidney

2 Nephrectomy is an operation which is reserved for the most severe cases of the group under consideration and is rarely indicated, except for massive and uncontrollable bleeding in focal glomerulonephritis

3 Nephrotomy is at present seldom done in this group of cases, most authors agreeing that decapsulation offers a better outlook for the patient and more nearly fulfills the indications for operative interference

4 Denervation is also of value Removal of the sympathetic nerves, accompanying the vessels, results in vasodilatation and increased blood supply to the kidney When decapsulation is done in these cases, sympathectomy is usually also indicated

Anuria, in acute hemorrhagic nephritis, that does not respond to medical management and which persists for more than twenty-four hours, is an indication for decapsulation Decapsulation is also indicated in the convulsive uremia of acute nephritis Decapsulation, with occasional nephrotomy, has proven to be a life saving measure in selected cases

Nephrotomy and decapsulation are of value in some cases of acute toxic nephroses such as may result from bichloride poisoning Recoveries have been reported

Although there have been some favorable reports of the results of decapsulation, denervation, and nephrotomy in the treatment of subacute and chronic nephritis and uremia, relief for these patients is only temporary, and the results do not appear to warrant these measures

5 Splanchnic Sympathectomy and Rhizotomy Some valuable experimental and clinical observations have been made recently on the etiology of essential hypertension Attempts have been made to treat this condition surgically in its particular relation to renal involvement

Goldblatt produced hypertension experimentally in animals by partial compression of the renal artery over a long period of time It is evident that reduced blood flow to the kidney, with ischemia, is an important factor in the development of hypertension Attempts have been made clinically to increase the blood flow to the kidney in these cases, by producing vasodilatation

Extensive bilateral splanchnic nerve resections, and bilateral anterior root resections, together with partial adrenalectomy and adrenal denervation, result in destruction of the sympathetics Vasodilatation of the arterioles results, blood pressure is reduced, and many of the symptoms are alleviated Crile, Peet, and Adson have reported on a large series of operated cases It is evident that the favorable results are only temporary in the vast majority of cases, and it is questionable therefore whether such extensive procedures should be attempted

PART SEVEN

UROLOGY IN THE FEMALE AND IN CHILDREN

CHAPTER	PAGE
45 UROLOGY IN THE FEMALE	815
46 UROLOGY IN CHILDREN	846

ORIENTATION

Urological conditions in women and in children do not differ in their fundamental aspects from those found in men, yet so little attention has been given to them by gynecologists on the one hand and by pediatricians on the other, that but little progress has been made until recently in many border-line affections. Comparatively few gynecologists can do a cystoscopy and ureteral catheterization, so that many urethral and bladder lesions are overlooked because the symptoms are so often ascribed to some cervical or uterine pathology. Only of recent years, have pediatricians begun to realize the necessity of a complete urological study in cases of pyuria, fever of obscure origin or enuresis. The tendency toward developing a specialty within a specialty has made such progress that some very competent urologists in this country are devoting their energies to gynecological and pediatric urology respectively. The anomalies of the urethra termed hypospadias, and epispadias, although less common than in males, are found in females. A frequent source of bleeding from the female urethra is a granuloma termed caruncle, presenting at the external meatus, as shown in Figure 571, of soft consistency and bleeding very easily. It disappears as a rule following fulguration unless recurrence takes place as the result of persistent urethrovaginal infection. Diverticula and carcinoma of the female urethra are far less often seen clinically than the corresponding conditions in the male. Birth trauma is an important etiological factor in conditions for which first the gynecologist and later the urologist are consulted. A cystocele or prolapse of the bladder as the result of a relaxed anterior vaginal wall is often responsible for the persistence of a urethrocystitis in spite of all nonoperative treatment.

Vesicovaginal or vesicoureterovaginal fistulae may be a sequel of a difficult labor or of some vaginal or uterine operation and call for team work by the gynecologist and the urologist.

The treatment of pyelonephritis during pregnancy and in the puerperium has made remarkable progress since it has been found that dilatation of the upper urinary tract is an accompaniment of a normal pregnancy. This slowing up of the column of urine in the ureter and renal pelvis favors the localization of bacteria with the resultant production of an acute or chronic renal infection, which responds rapidly to the use of an inlying ureteral catheter or drugs like mandelic acid and sulfanilamide. Only in occasional cases are more radical measures like nephrostomy or nephrectomy indicated.

A fairly large proportion of urological conditions in infancy and childhood are due to obstructive lesions of congenital origin. Valve formation in the posterior urethra in boys, contracture of the vesical neck in both boys and girls and stricture of the ureter are examples of such obstructive conditions. In addition, dilatation of the upper urinary tract due to neurogenic dysfunction is a cause of stasis which favors infection. Both in women and in female children, an ectopic ending of one or both ureters must always be looked for in cases of diurnal and nocturnal incontinence.

Pyuria in infants and children is an indication for a complete urologic study which has been greatly simplified through the manufacture of baby-size cystoscopes equipped for uni- or bilateral ureteral catheterization. It was hoped that excretory urography would render cystoscopy and ureteral catheterization unnecessary in many urological conditions observed in children, but this has not proven to be the case.

CHAPTER 45

UROLOGY IN THE FEMALE

THE FEMALE URETHRA

ANATOMY

ANOMALIES

DIVERTICULA

PROLAPSE

ACQUIRED STRICTURES

BENIGN NEOPLASMS

MALIGNANT NEOPLASMS

INFECTIONS OF URETHRA AND BLADDER

SPECIFIC AND NONSPECIFIC URETHRITIS

NONSPECIFIC INFECTIONS OF THE URETHRA AND BLADDER

MODES OF INFECTION

PREDISPOSING CAUSES

PATHOLOGIC CHANGES

SYMPTOMS

DIAGNOSIS

TREATMENT

TRICHOMONAS VAGINALIS INFECTIONS OF THE

LOWER URINARY TRACT

INCONTINENCE OF URINE IN THE FEMALE

VERICAL CAUSES

EXTRAVERICAL CAUSES

STASIS

TREATMENT

UROGENITAL FISTULAE

UROLOGIC COMPLICATIONS OF GYNITAL ORIGIN

CANCER OF THE CERVIX

IRRADIATION OF THE UTERUS

RENAL INFECTION IN PREGNANCY AND THE

PUERPERIUM

FEMALE PSEUDHERMAPHYRODITISM

Only those urological conditions in the female which differ materially from those observed in the male will be discussed in this chapter. These differences are less marked in the upper than in the lower urinary tract. Changes in the former incident to pregnancy and the puerperium call for special consideration as etiological factors in renal infection. Abnormal mobility and ectopic ureteral ending occur more frequently in the female. Owing to the close anatomical relation of the internal genitalia to the lower ureter, bladder and urethra in the female, certain conditions which are complications of parturition or of operations, treatment or infection of the female genitalia are of special interest to the urologist. We shall follow the same order as in the preceding chapters and begin with the urethra.

THE FEMALE URETHRA

ANATOMY

The urethra forms a double curve like those of an elongated letter S, the curve corresponding to the posterior portion being more marked than that of the anterior portion.

The length as given by various anatomists varies slightly. According to Poirier and Charpey, it is 3 cm. to Piersol 3.5 cm. (about one and a half inches) and to Sappey 3.8 cm.

There are three portions: a pelvic portion from the bladder to the point of entrance into the triangular ligament; a membranous portion which, as in the male, lies between the two layers of the triangular ligament and a vaginal portion. The membranous portion is surrounded by the fibers of the external sphincter, a voluntary muscle which is usually poorly developed.

It is possible to palpate the urethra under pathologic conditions as a firm cord-like structure through the anterior vaginal wall and urethral secretion for smears and cultures can be obtained by pressure along the posterior wall of the urethra, i.e., along the anterior wall of the vagina.

The lumen of the urethra is a potential one; the folds of mucous membrane being in apposition until fluid or an instrument is introduced. The average cir-

cumference of the lumen when the folds are obliterated corresponds to a 26 F sound, although the meatus will admit a larger one

There are three coats, a mucous, a submucous and a muscular The first named is of chief interest clinically The epithelial lining is of the stratified squamous type except close to the bladder where it resembles that of the epithelial lining of the latter, in being of the transitional type

The glands of Skene lie in the submucous and muscular coat along the posterior wall of the urethra, usually one on each side of the median line Their excretory ducts (Fig 208) are to be found about 5 mm behind the external meatus When infected, as often occurs in gonorrhoeal urethritis, pus can be seen to escape from the openings on the mucosa of the posterior wall of the urethra by exerting slight pressure through the anterior vaginal wall

Other Glands There has been a great deal of discussion as to the incidence and distribution of other glands than those of Skene MacKenzie and Beck (*Jour Urol*, 1936, 36, 414) examined fifty urethrae obtained at necropsy Thirty were adults aged forty or above, seventeen were children aged four years or younger and the remaining three were ten, thirteen and twenty years of age, respectively The authors believe that the urethrae of children are best for such a study Periurethral tubular structures, distinct from Skene's glands, were found in the anterior and occasionally in the middle thirds True periurethral glands do not occur in the posterior third This latter observation is confirmed by Petrova and associates (*Arch Gynök*, 1937, 163, 343) They examined the urethra of 60 cadavers, the majority had been 18-40 years old, a lesser number 41-55 and a very few 56-70 years of age Serial cross sections were studied in most cases, only a few in longitudinal serial sections In 15 women, evidences of a urethritis were found, hence these were excluded

THE FEMALE URETHRA CAN BE DIVIDED INTO AN ANTERIOR PORTION WITH GLANDS AND A POSTERIOR PORTION WITHOUT GLANDS, this histologic study showed The glands in the former resemble those of the male prostate, which corresponds to the embryologic origin of the female urethra There was a marked variation in the number of glands found in the 45 urethrae In a first group (57.7 per cent of the 45 urethrae examined), there was a marked development of glands of tubular and acinous type, which penetrated deeply beneath the mucosa In a second group (31.1 per cent), there were very few glands and these were quite superficial In a third group (11.1 per cent), neither lacunae nor glands were to be found the entire length of the urethra The large percentage in the first group explains why urethritis is so resistant to treatment in many women

ANOMALIES OF THE FEMALE URETHRA

Absence of the Urethra Only seven reported cases of this anomaly could be found by Stevens (*Jour Amer Med Assn*, 1936, 106, 89) One of us had the opportunity of seeing a case of congenital absence of the urethra in a girl nine years old with a vesicovaginal fistula and a solitary kidney at the clinic of Prof Legueu

Double Urethra Four cases have been found according to Stevens (*loc cit*) Since appearance of his article, a fifth case was reported by Schinagel (*Urol and Cut Rev*, 1936, 40, 398) In a patient, 29 years of age, who sought relief for incontinence, an accessory urethral opening was found close to the normal one

The accessory canal was only 2.5 cm. long. In Dannreuther's case the accessory urethra was complete, i.e. ended like the normal one in the bladder.

Diaphragms or Valves. These are usually located at the external meatus. Stevens collected 14 reported cases in which the obstruction was complete in 11 and incomplete in 3. The diaphragm was located at the external meatus in 10, in the middle third of the urethra in two, in the posterior third in one and at the internal meatus in one.

Congenital Strictures. The incidence of this anomaly is but slightly less in girls than in boys, according to Campbell. The tight orifice causes dysuria, frequency, urgency and the back effects on the bladder and upper urinary tract can be demonstrated urographically. Stevens (*loc. cit.*) reported five cases, the age of the youngest child being twelve months in whom the clinical picture was that of a pyelocystitis. In a girl, eight years old, the chief complaint was difficulty in urination.

Following meatotomy, periodic dilatation of the incised orifice should be done until the orifice remains permanently widely open.

Hypospadias. This occurs much less frequently in the female than in the male and is usually discovered during an examination for the source of an incontinence. There are three forms (Blum) according to the extent to which the floor of the urethra exists. In complete or total hypospadias there is a wide communication of the vagina and the urethra from the external meatus to the bladder neck (Fig. 569). In a case reported by de Gironcoli (*Zeit. Urol. Chir.* 1936 42 152) the incontinence persisted in spite of a successful plastic operation for a total hypospadias in a girl 22 years of age. Cystoscopy which could only be done following the plastic, revealed the absence of a right ureteral orifice. Further study showed that the ureter of this right kidney ended ectopically in the vestibule. The incontinence ceased after reimplantation of this ureter into the bladder.

Epispadias. In this anomaly there is incomplete or complete absence of the upper wall of the urethra. Incontinence is the rule and is usually complete or nearly so. The only exception is when the epispadias is of the first degree. Incontinence according to D. M. Davis (*Surg. Gynec. and Obst.* 1928 20 680) may however exist with slight degrees of urethral deformity in some cases while in others excellent urinary control may be present even though there is extreme urethral deformity. Davis was able to find 69 cases of typical epispadias with incontinence up to 1928 and others have been reported since then.

THE SIMPLEST CLASSIFICATION from a surgical point of view is into cases without and those with incontinence. The former require no treatment while those with

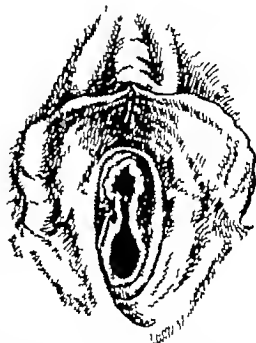


FIG. 569.—Complete type of hypospadias in the female. This case was reported by Gironcoli (*Zeit. Urol. Chir.* 1936 42 155). There was an absence of the floor of the urethra from the external meatus to the vesical neck. (Courtesy of Prof. F. de Gironcoli of Padua, Italy.)

incontinence should be operated. According to Davis (*loc cit*) the operative procedure should consist of only two steps. The first should be a plastic repair of the defect comprising (a) wide exposure of the affected areas, (b) sufficient excision of excessive mucosa, (c) accurate approximation by suture of the halves of the defective internal sphincter muscle over the anterior aspect of the newly formed vesical orifice and (d) diversion of the urine during the healing by drainage (suprapubic) of the bladder. This will effect a cure in most cases. If not, the Deming gracilis muscle plastic operation (*Jour Amer Med Assn*, 1926, 86, 822) should be performed.

DIVERTICULA OF THE FEMALE URETHRA

Two classifications have been proposed, one into congenital and acquired, the other into true and false. The former grouping is the one which has been generally adopted, but even here, there is a difference of opinion as to whether the congenital type exists. Latzko (*Handb Urol*, 1928, 5, 921) states that certain reported cases, those of Veit, Huehne and Fromme, appear to be unquestionably of congenital origin, especially Fromme's case, in which an ectopic ureter ended in the diverticulum. Glingar more recently reported (*Wien Med Woch*, 1936, II, 1000) four cases in which the clinical symptoms were those of a cystitis. In three of the cases, the history pointed definitely to a congenital origin.

The opinion of the majority of urologists is that there is no certain way to determine whether the diverticulum is of congenital or acquired origin (except in such cases as that of Fromme just cited), but that most commonly they are sequels of abscess formation in a periurethral gland which has ruptured into the urethra. Latzko (*loc cit*) believes some diverticula follow injury to the urethra during labor. The cavity filled with infected, often foul-smelling, urine persists. If the opening into the urethra is minute, retention follows with the formation of a suburethral abscess. If the opening into the urethra is relatively large, the history is that of dribbling after urination or the constant escape of pus or infected urine.

In a certain number of cases, calculus formation takes place in the diverticulum and such a calculus may be large enough to cause acute retention as in a case reported by Bartolozzi (*Clinica Chir*, 1936, 12, 163). As a rule there is only a single diverticulum but Furniss (*Jour Urol*, 1935, 33, 384) reports four cases in which there were two, one on each side of the median line.

Symptoms. The ages of the patients varied between 5 and 65 years. In many there is a history of prolonged labor. If there is acute retention, there will be a complaint of pain referred to the vagina or urethra, burning on urination or even partial retention of urine. If the abscess ruptures into the urethra these symptoms disappear, pus appearing in the urine until the cavity fills again.

In some cases, there is a complaint of dribbling after urination or symptoms resembling those of a cystitis such as pain, frequency and even urgency.

The diagnosis by palpation is not difficult, if the diverticulum is filled, in other cases it can only be made by urethroscopy and urethrography. In typical cases, a fluid filled pouch of variable size presents in the urethrovaginal septum on palpation or is seen (Fig 570) on separating the labia. On pressure over the sac, infected urine or pus escapes from the external meatus. The sac is always larger during urination. A search should be made for urethral diverticulum in every patient who complains of pain on urination accompanied by the escape of

pus from the external meatus. The diagnosis can be confirmed by search during urethroscopy for the opening which is almost invariably on the posterior wall i.e., floor. The best method to visualize (Fig. 570) the size of the diverticulum is by urethrography (see Chapter 7).

Treatment. In the majority of patients conservative measures will be unsuccessful. The treatment of choice is excision from the vaginal side. Diversion of the urine by suprapubic cystostomy for 18 days is recommended by Shivers and Cooney (*Jour Amer Med Asso* 1934 102 997) to promote healing and prevent formation of a urethrovaginal fistula following excision.

PROLAPSE OF THE URETHRA

This condition so far as its etiology and pathology are concerned resembles greatly prolapse of the rectum. Like the latter it is an eversion of the mucosa

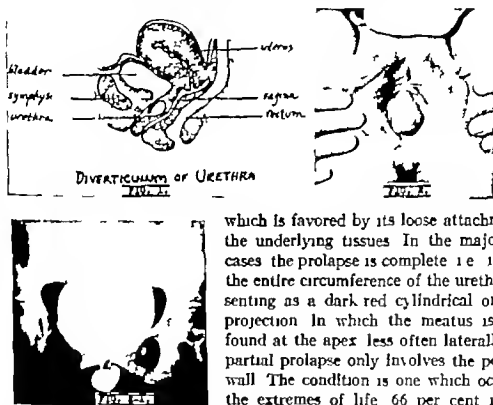


FIG. 570.—Three drawings of case of diverticulum of the female urethra (Courtesy of Dr. R. E. Cone and of the Urologic and Cutaneous Review). From left to right, note sectional view showing location of the diverticulum, appearance after separation of labia and the right cystourethrogram with diverticulum filled with opaque medium.

dren 22 per cent in women above 50 and only 12 per cent between 15 and 50 according to Kleinwaechter.

The onset is acute following increased abdominal pressure such as straining in constipation, prolonged labor, neoplasms of the urethra, and any cause of vesical tenesmus. In elderly women the onset is often gradual or there are no symptoms indicating the presence of a prolapse until bleeding occurs. Chauvin (*Arch Mal Reins* 1935 9 103) has called attention to the frequency of dilated vessels and even of glands in sections from cases of prolapse of the urethra in women above fifty. This increased vascularity explains the bleeding which is often the first sign of the presence of a prolapse. In some of these elderly patients circu-

latory disturbances complicated by infection may lead to superficial areas of necrosis simulating those seen in neoplasms

The differential diagnosis between prolapse, caruncle and cancer of the urethra will be discussed under the last named heading

Treatment Simple reduction and elimination of the causes of straining suffice, at times, in children and should be given a trial before resorting to (a) ligation of the protrusion as proposed by Fritsch and employed with success by Campbell, (b) deep fulguration at four points as used by Livermore, (c) suprapubic mobilization of anterior bladder wall and its suture to anterior abdominal wall and periosteum of pubic bone and (d) electrocoagulation of the entire prolapsed mucosa as used by Corbus and O'Connor

ACQUIRED STRICTURES

We have discussed the congenital type as found in female infants and older children at the beginning of this chapter

Incidence The acquired type is usually seen from the age of 25 upwards. There is still much difference of opinion as to the frequency of the acquired type and the symptoms which they give rise to. In a recent article, W. E. Stevens (*Jour Amer Med Asso*, 1936, 106, 89) states that he found strictures partly or entirely responsible for the symptoms of urinary disturbance in 458 or 37 per cent of 1227 women. About 85.6 per cent were found at the external meatus and appeared as a ring or circular band of tissue on withdrawal of a bulb bougie. He believed that practically all congenital strictures were of this type, representing, for the most part, a persistence of the cloacal membrane, but that strictures in the canal and at the internal urethral orifice were of acquired origin. This frequency of occurrence is opposed by Wynne (*Amer Jour Obst*, 1934, 27, 373) who maintains that acquired strictures of the urethra (a) cause few symptoms in women, (b) that the annular orifice per se should not be regarded as a stricture, being observed in one half of his cases, and (c) that even when only a 24 F bulb bougie can be passed there are no urinary symptoms.

We agree with Wynne, from our personal observations, that the external meatus is narrow or less dilatable than the portion immediately behind it and that on withdrawal of the bulb bougie the orifice appears ringlike. We have noticed a very slight resistance at the meatus to the withdrawal of a No. 25 bulb bougie by a fold of mucosa which was supple, but would not regard this as a stricture capable of giving rise to symptoms.

According to anatomists like Poirier and Charpey, the caliber, i.e., circumference of the normal female urethra corresponds to that of a 22 F sound. Stevens (*Jour Urol*, 1936, 35, 69) states that he has calibrated the urethra of 118 women who had never suffered from symptoms suggestive of urinary tract pathology. These showed an average size of 26 F. Van de Warker believes it to be from F 23 to F 28, Folsom from F 30 to F 32, Herman F 29 and Azevedo F 22. Wynne (*loc cit*) states the normal external urethral orifice varies in size from F 18 to F 30. Stevens believes that a urethra below F 26 is very often responsible for symptoms and pathology such as chronic infection in both the urethra and upper urinary tract.

It is evident that the question of the incidence of urethral stricture and the extent to which it gives rise to symptoms is far from settled. A uniform caliber

must first be adopted and any case in which a narrowing or 'hang' is found on withdrawal of a bulb bougie must be studied in order to determine whether the symptoms can be ascribed to such a narrowing or to other pathologic changes.

Examination. It is generally agreed that gonorrhoea and nonspecific chronic infections are responsible for nearly all strictures in women. The best method of instrumental examination is passing a bulbous bougie (Fig 74) and then noting a resistance or 'hang' upon its withdrawal. Craibtree and associates (*Jour Urol*, 1936 35, 52) A. E. Stevens and others warmly recommend urethrography (see Chap 7) as a diagnostic method.

The treatment should include (a) the passage at intervals of a week or ten days of short steel sounds (Fig 80) avoiding the use of any force. The increase in caliber of sounds employed at successive sittings should be very gradual. (b) The instillation of one of the colloidal silver preparations should follow the passage of the sound to combat a coincident infection.

BENIGN NEOPLASMS OF THE FEMALE URETHRA

Fibroma, fibromyoma and pure leiomyoma have been reported in a few cases. As a rule they are sessile but they may be pedunculated. Some have their origin in the urethrovaginal septum. Recently (*Zentralbl Chir* 1932, 2696) a case of cavernous hemangioma was reported. The most frequent types of benign neoplasms are the papillomas, polyps and caruncles. The majority of these develop as the result of chronic infection, usually of the upper urinary tract.

Papilloma. Kreutzmann (*Surg Gynec. and Obst* 1924 38 475) was only able to find 40 reports of papilloma of the female urethra. They were located close to the bladder on the anterior and lateral walls and extended about 0.5 cm outwards. They cause few symptoms but are indicative of other pathology. In 42 per cent of the cases there was a previous history of cystitis.

Polyps as a rule are seen on urethroscopic examination close to or on the margin of the vesical orifice as translucent projections with a long narrow pedicle. They are usually multiple and seldom give rise to any symptoms. The latter when present, are due to an underlying chronic infection of the urethra and trigone. It is useless in our opinion to fulgurate these tags or polyps which are not true neoplasms but simply of inflammatory origin and will constantly recur unless the underlying pathology most often in the upper urinary tract is eliminated.

Caruncles. These are small red tumors (Fig 571) usually found on the posterior, less often on the lateral and rarely on the anterior margin of the external meatus. They may be sessile and fixed or pedunculated and freely movable. They vary in size from that of a pea to that of a walnut. They are very vascular and bleed easily. As a rule only one caruncle is visible but there may be two or three. As to age, they are most often found between the ages of 20-60 years, rarely in children. They may give rise to pain on urination, bleeding and frequency and are very sensitive to the touch. Histologic examination reveals an edematous inflammatory tissue (Gutierrez) with lymphocytic and plasma-cell infiltration and large thin-walled capillaries. They are a sequel of chronic infection of the urinary tract. The differential diagnosis from prolapse and carcinoma will be taken up in connection with the latter.

Electrosurgical resection is the best method of treatment infiltration with 2 per cent novocain at four points, then grasping the tumor and making traction to see the point of implantation, followed by use of the cutting current

MALIGNANT NEOPLASMS

Up to 1935, Menville (*Surg Gynec and Obst*, 1935, 61, 229) could only find reports of 149 cases of carcinoma and 22 cases of sarcoma of the female urethra Since publication of this article, 21 additional cases of carcinoma have been reported, making a total of 170 cases to August 1937 The average age in 109 cases was 53.4 years

CARCINOMA

The following three types of carcinoma are found

1 The epithelioma or squamous-celled form originating from the mucosa lining the urethra This is the most common form

2 The malignant papilloma

3 The adenocarcinoma which is infrequently encountered and which may arise from Skene's glands, from the glands of Littre or from the few gland elements situated periurethrally

Combinations of these three tissue groups may be encountered, in which, as mentioned by Menville, the tumors appeared to be of the mixed connective tissue and epithelial type

Symptoms There are no characteristic symptoms In the ten cases observed at The Mayo Clinic, difficulty in voiding or retention was noted

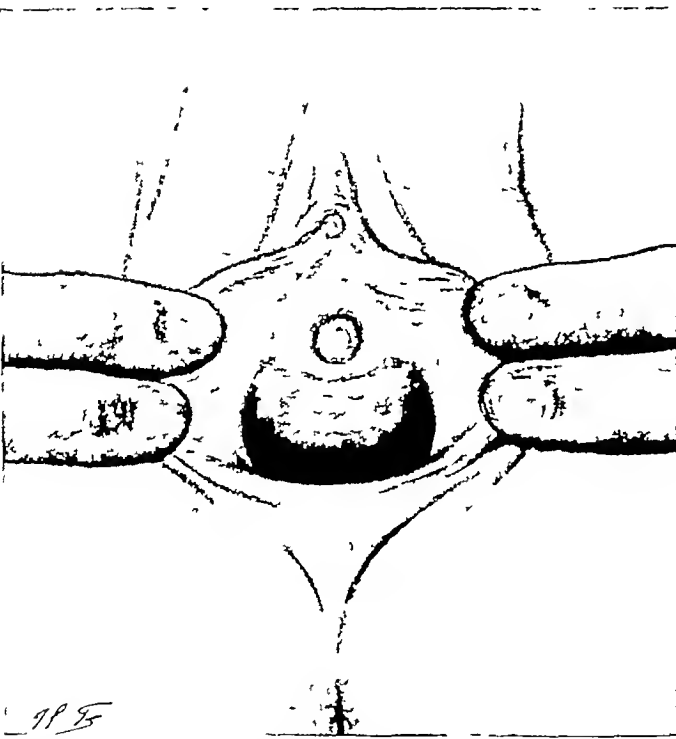


FIG 571—Caruncle of the female urethra (Courtesy of Dr R. Gutierrez)

in 6, hematuria in 4, tumor or visible (inguinal node) metastasis in 4, pain or dysuria in 4, frequency in 2 and watery discharge in 2 In 17 cases reported by E. M. Watson (*Jour Urol*, 1936, 35, 655) hematuria or an irregular bloody discharge had been the presenting symptom in 10 cases In 8 cases, pain, frequency and burning associated with hematuria were complained of In 4 cases, the patient had felt a "lump" along the urethra In 2 cases, urinary retention and in 2 others incontinence of an overflow type was noted

In general, the symptoms and signs are (a) those of obstruction, (b) of a visible mass, and (c) of infection according to Menville

Differential Diagnosis The chief conditions from which carcinoma of the

urethra must be differentiated are caruncle and prolapse. The former is smooth red tender not indurated seldom more than 1 cm. in diameter and usually situated on the posterior margin of the meatus. Prolapse is continuous with the mucosa of the urethra, oft, not tender easily torn and except in elderly women shows no tendency to bleed.

Fortunately the entire urethra can be palpated either over a small sound or with its walls approximated. All tissue removed from the urethra such as caruncles, polyps or prolapse should be examined for malignancy. When any appreciable induration is felt along the urethra the base of the lesion should be inspected frequently with the aid of the Geringer or Dourmashkin urethroscope. If

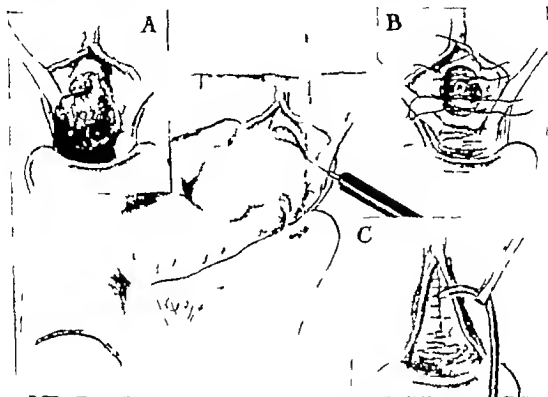


FIG. 572.—Carcinoma of the female urethra (Courtesy of Dr. Ernest M. Watson and *Journal of Urology*). Cutting current resection undermining the vaginal mucosa. This may be carried down to the ramal of the pubis if advisable. Insert A. Massive type of this carcinoma before amputation. Insert B. Urethra cut across. Anterior portion removed with tumor leaving most of sphincter muscle. Sutures in place to obliterate denuded surface. Insert C. Complete wound closure. Urethra fixed by sutures to vaginal mucosa. Catheter in place for urinary drainage.

any proliferation or unreasonably delayed healing is encountered a second or even a third biopsy should be made (Watson).

The gross appearance in the 17 cases reported by Watson varied from an irregular granular easily bleeding mass (Fig. 572) half the size of an egg down to a small rounded elevation involving the inferior lip of the meatus no larger than half a small cherry. Palpable enlargement of the inguinal lymph nodes was present in 7 of Watson's 17 cases and in one third of those reported by Ehrendorfer. Such a metastasis may be the first sign. In general the prognosis is bad if the inguinal lymph nodes are already involved when the patient is first seen.

The treatment includes (1) excision of the tumor by the cutting current (Fig. 572) (2) Roentgenotherapy and (3) Radium emanation implantation or various combinations of these methods.

INFECTIONS OF THE URETHRA AND BLADDER

SPECIFIC AND NONSPECIFIC URETHRITIS

The former will be discussed under gonorrhea in the female and the latter in connection with cystitis in women

NONSPECIFIC INFECTIONS OF THE FEMALE URETHRA AND BLADDER

The infections of the urethra and bladder resemble each other so closely clinically that they will be considered together here. In this section only nonspecific infections, i.e., those due to the ordinary Gram-negative and positive bacteria, are included. Urethrocystitis as a complication of gonorrhea in the female will be taken up later in this chapter. As a sequel of renal tuberculosis, urethrocystitis is discussed in Chap. 39. To avoid unnecessary repetition of previous chapters especially the one on cystitis, only essential differences between nonspecific infections as observed in the male and female can be considered in this section.

Modes of Infection

Extension to the urethra and bladder from a cervicitis and vaginitis is favored by the proximity of the external meatus to the vaginal orifice (Fig. 207). This must be constantly kept in mind both in the diagnosis and treatment of lower urinary tract infections in the female, at all periods of life. A report by Herrold and Maryan (*Surg. Gyn. and Obst.*, 1936, 70, 85) emphasize this point. The symptoms in 32 cases of urethrocystitis were frequency, burning, intermittent deep pain over the pubis, low backache, pain radiating into the groin, thigh and toward the ureter. Of the 32 cases, 29 were followed long enough to permit an analysis to be made of the effect of electrocoagulation of the cervical canal. In a few, this treatment was given a second or third time. Relief of the bladder symptoms occurred in 19 of the 29 cases. The cultures from the cervix revealed streptococci in many cases like those found in the urine. When *B. coli* were found in cultures from the urine of ten cases, seven had none in the cervix, two only a few colonies, and one, many *B. coli*. This shows that inoculation did not take place from the cervix in these cases, but from other sources, most commonly a renal infection.

The persistence of bacteria of the *B. coli* group in the urine of women presenting the symptoms of a urethrocystitis, if it persists in spite of treatment, must lead to the examination of the upper urinary tract as the source of the infection.

Predisposing Causes

1. IN THE URETHRA. Either singly or in combination the various conditions found in the female urethra which were described in the previous portion of this chapter, may favor localization of bacteria in the urethra with subsequent extension and by continuity of tissue or reflux of the urethral urine, into the bladder.

2. IN THE BLADDER. Calculi and diverticula are less frequently encountered in the female, than in the male bladder. Foreign bodies, however, are more common in the female bladder. Obstructive lesions at the vesical orifice play a more important part in favoring infection in the female bladder than was formerly thought. Caulk first called attention in 1921 to a condition which he termed contracture of the vesical neck in the female similar to that found in the male. His observations have been confirmed by a number of other urologists. In a recent paper, Caulk and Patton (*Jour. Urol.*, 1935, 33, 504) reported 12 cases, the youngest patient being 29 and the oldest, 74 years of age. In only two of the cases

was there any median elevation to be seen at urethrocystoscopy comparable with that seen in the male the remainder revealing simply a stiffening and pallor of the lower sphincter segment. In addition to the cases in adults various forms of vesical neck obstruction were observed in six little girls. Urinary symptoms were present in all of the cases. Nine of the adults had residual urine varying in amount from 30 to 1000 cc. Four had over 400 cc. In most cases a rather dense fibrosis was found on histological examination. For treatment, cautery punch operation was employed in both adults and children.

Pathologic Changes

1 IN THE URETHRA. The changes incident to both acute and chronic non-specific infections do not differ greatly from those observed in the male urethra

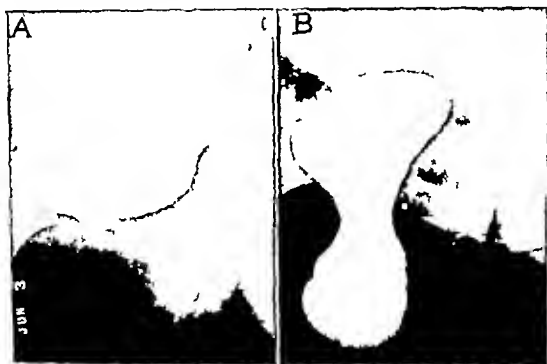


FIG. 573.—Cystograms from case of cystocele (kindly loaned by Drs. W. E. Stevens and S. P. Smith). A. Position of bladder when patient is relaxed. B. Position of bladder when patient is straining.

The important part played by infection of Skene's glands has been known for many years. American urologists especially Folsom have called attention to the importance of taking into consideration the perilurethral glands as foci of reinfection and recurrence of symptoms. Ormond (*Jour. Urol.* 1935 33 483) reported 93 cases varying in age from 11 to 71 years in which frequency and dysuria were the chief symptoms. The term granular urethritis has been applied to this form of infection although the inflammatory reaction soon involves the trigone. In the mildest type the mucosa of the posterior urethra and trigone are simply reddened. In more severe cases the glistening appearance is replaced by a rough granular appearance from which the condition takes its name. The bacteria found were those in all forms of nonspecific urinary infections.

2 IN THE BLADDER. We have already discussed submucous or interstitial cystitis in Chap. 25 but on account of its predominant occurrence in women we will recall the essential features again here.

CHRONIC INTERSTITIAL CYSTITIS (HUNNER'S ULCER). The pathologic changes

are those seen in chronic inflammation such as polymorphonuclear and round-cell infiltration and fibrosis, most marked in the submucosa which may extend into the perivesical tissues. In certain areas, the perivascular infiltration is especially noticeable. The ulcer may be so small as to escape attention or there may be a linear break in the continuity of the mucosa. In either case, free bleeding occurs when the bladder is distended. Both types of lesions most frequently are found at the dome or posterolateral wall of the bladder.

THE EFFECTS OF PARTURITION ON THE BLADDER According to Crabtree and co-workers (*Jour Urol*, 1936, 35, 52) the two major defects of the bladder which are the result of parturition, (a) descensus of the bladder as a whole, and (b) local protrusion of the trigone and whole bladder base are the result of destructive injuries to the trigonal muscle and the sphincter muscles of the urethra, and are often associated with weakening of the perivaginal fascia and the muscle supports

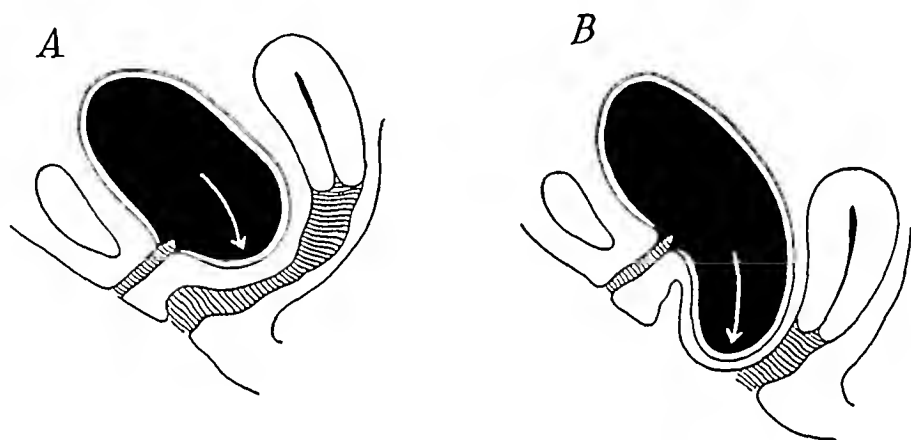


FIG 574—Various degrees of cystocele illustrating how infection is favored by residual urine
A Moderate cystocele The arrow points to residual pouch
B Marked cystocele

of the perineum. There are three types of cystocele: (a) anterior to Mercier's bar, (b) posterior to it, and (c) herniation of the whole bladder of variable degree (Figs 573 and 574).

Symptoms

The clinical pictures already described in Chap. 25 as characteristic for acute and chronic cystitis in the male, hold true for the female, with slight modifications.

In acute cystitis in the female, the outstanding features of the clinical picture are (a) frequency and urgency, even to the point of having tenesmus, (b) pain on urination, referred to the neck of the bladder and urethra, and (c) more or less pyuria and hematuria.

In CHRONIC URETHROCYSTITIS in the female, two types of clinical pictures are encountered:

(A) CASES IN WHICH FREQUENCY, PAIN ON URINATION AND PYURIA, (less commonly) HEMATURIA, predominate.

(B) CASES IN WHICH THE OUTSTANDING FEATURE IS FREQUENCY WITH OR WITHOUT CONCOMITANT PAIN AND PRACTICALLY NEGATIVE URINE from a cytological point of view. In some of these chronic cases, difficulty in voiding, incomplete or complete retention or even incontinence from overflow, may predominate in the clinical picture. This latter group includes the cases in which a urethral stricture

or some type of vesical neck obstruction has been accompanied by a chronic urethrocystitis.

Diagnosis

In acute urethrocystitis the diagnosis is not difficult. In taking the patient's history the probable cause can be ascertained by inquiries as to whether catheterization without the necessary precautions has been done, the introduction of foreign bodies or injury during coitus. The patient's urine should be obtained by catheterization at the time a first treatment is given. The bacteriologic and cytologic examination of the urine will confirm the clinical diagnosis of an acute cystitis by the presence of pathogenic bacteria, as well as pus and red cells in variable amounts. Urethrocystoscopy is strictly contraindicated in the acute stage and should be postponed for at least 3-4 weeks after subsidence of the symptoms.

IN THE TWO FORMS OF CHRONIC URETHROCYSTITIS inquiry should be made as to the relation of the recurrence or persistence of symptoms to certain foods, to periods of mental strain, to coitus, to a previous pregnancy or puerperal infection, passage of calculi, renal infections.

ALLERGY We will only mention the question of allergy in relation to bladder symptoms such as frequency. Although it is not quite clear as to why the ingestion of certain foods should give rise to bladder symptoms, the fact that it does occur cannot be denied. Inquiry should be made with this etiology in view in taking the clinical history.

MENTAL STRAIN Every urologist has occasion to see women and even girls whose chief complaint is frequency and urgency whenever they are under much mental strain. Objective examination is perfectly negative and the diagnosis must be made from the clinical history.

THE INSTRUMENTAL EXAMINATION in the female only differs from that of the male in one respect. Owing to the inability to retain sufficient water in the short female urethra during urethrocystoscopy it is necessary simply to employ the dry (endoscopic) method which is not very satisfactory or some form of instrument of the Dourmaashkin type in which the walls of the urethra are prevented from collapsing by the fluid ordinarily used in cystoscopy.

The changes which take place in the female urethra and bladder as the result of chronic infection do not differ from those described in Chap. 25.

CHRONIC INTERSTITIAL CYSTITIS The fact that chronic interstitial cystitis (Hunner's ulcer) occurs four times as often in women as in men merits repetition of the symptoms and cystoscopic findings here. The etiology is still obscure, the urine being as a rule negative from a cytologic and bacteriologic point of view. The chief complaints of the patient are frequency and pain referred to the dome of the bladder. The frequency and pain seem to appear in cycles, there being periods of days to weeks in which they are very marked, followed by intervals of variable duration of comparative comfort. At times there is urgency and tenesmus. At cystoscopy the mucosa appears normal except over one or two areas high up on the posterior wall or at the dome of the bladder where a minute linear break in the continuity of the mucosa is visible from which bleeding is taking place. Around the area the blood vessels appear injected. A single fulguration rarely suffices; the average number needed is 6, but some cases are very resistant and require more. In a recent personal case no relief was obtained until the area was excised.

URETHROGRAPHY AND CYSTOGRAPHY AS DIAGNOSTIC AIDS These are assuming a constantly increasing importance in the diagnosis of urethrovvesical conditions relating to pregnancy, parturition and subsequent gynecological history. Recent contributions by Crabtree and co-workers (*Jour Urol*, 1936, 35, 52) and by Stevens and Smith (*Jour Urol*, 1937, 37, 194) have shown that urethrography and cystography ought to be a part of the routine examination of every woman who presents symptoms pointing to the urethra and bladder as the possible source of the same. Urethrography is very useful in the detection of diverticula and stricture. Inflammatory conditions are better seen through the urethroscope. Cystography is of less value than cystoscopy in the differentiation of a cystocele anterior to Mercier's bar from one posterior to this structure. It is in the third type of cystocele (Fig 574), i.e., in complete bladder-floor relaxation that cystography is of especial value in yielding graphic evidence of the degree of impairment. The degree of disability can be best estimated if cystograms are taken both in relaxation and straining for micturition. A voiding cystogram as in prostatics and other forms of bladder retention will indicate the residual urine. Cystometric studies made by Crabtree and co-workers confirm the observations of others that greater intracystic pressure is necessary for voiding with cystocele than in the normal bladder.

Urethrocystography is also indispensable in evaluation of the symptoms following gynecologic operations.

Treatment

ACUTE URETHROCYSTITIS

DIET AND MEDICATION The first indication is to relieve the frequency and pain on urination. The patient should be given a very bland diet, chiefly milk, toast, weak tea, cereals and only cooked fruits. It is unnecessary to push fluids. To relieve the burning on urination and pain from spasmodic contraction of the vesical sphincter, a mixture containing (for adults) 10 Gm (15 grains) of potass citrate and 8-10 minims of Tr. Hyoscyamus to the teaspoonful, given three or four times daily, usually is followed by immediate relief of the above symptoms. The patient must be instructed to stop this prescription at once if dryness of the throat indicates too great a hyoscyamus effect. A mixture containing only the potass citrate alone can then be continued. If the pain preceding, during or after urination is not relieved by the above medication, suppositories containing 0.01 Gm (one-sixth grain) extract of opium may be given.

REST AND HEAT Rest in bed, hot sitz or whole baths and hot compresses over the suprapubic region are valuable adjuvants to the above medication. The less that is attempted in the way of local treatment until the acute symptoms subside, the better, in our opinion. Under no circumstances is urethrocystoscopy advisable during the acute stage. Urinary antiseptics are also contraindicated unless further experience with sulfanilamide should show that it will be of benefit in these acute cases.

CHRONIC URETHROCYSTITIS

EXAMINATION This will depend upon the results of the urologic examination, hence varies with individual cases. The first task is to ascertain the source and type (bacteriologic) of the infection. This includes the following examinations in the order named:

- 1 Of the genitalia especially of the cervix
- 2 Of the urethra for the various conditions described previously
- 3 Of the bladder for neck obstruction calculi diverticula (Fig 575), foreign bodies (Fig 323) cystocele (Fig 573) perivesical abscess ruptured into the bladder (Fig 600) evidences of neurogenic dysfunction (see Chap 28) and of neoplasms.

4 Of the upper urinary tract as the source of the chronic urethrocystitis keeping especially in mind the fact that a renal tuberculosis may masquerade for a long period under the picture of a nonspecific urethrocystitis

LAVAGE Therapeutic efforts must be directed toward the elimination of these various sources of infection. If an uncomplicated (by calculi stricture etc.) ordinary pyogenic infection of the upper tract is detected we have found that lavage of the renal pelvis with a solution of nitrate of silver in distilled water has given the best results. We begin with a weak (1:1000) and then a 1:500 solution until a 2 per cent strength is reached. Treatments ought not to be given oftener than every 7-10 days.



FIG. 575.—Cystogram from woman aged sixty-five showing diverticulum on right side of bladder and ureteral reflux on same side.

MEDICATION All that has been said regarding the use of ammonium mandelate sulfanilamide etc. in Chap 39 in the treatment of chronic renal infection need not be repeated here.

INSTRUMENTATION If the upper urinary tract has been excluded as the source of infection we employ dilatation of the urethra, beginning with a small (21 F) caliber straight sound (Fig 80) and advancing slowly to a 30 F at successive sittings, about 7-10 days apart. Force must

never be used because the attempt to pass a large caliber too soon will do more harm than good. The dilatation is followed by the injection of 5 cc. of a 2.5 per cent solution of one of the colloidal silver preparations through a Guyon instillator into the bladder and withdrawing the instrument slowly so as to distribute well over the urethral mucosa. Instead of the instillation of such a small quantity of solution the bladder and urethra can be irrigated with a 1:5000 nitrate of silver solution, a 1:4000 oxycyanide of mercury, a 1:4000 acroflavine solution or a 1:4000 permanganate of potassium solution. We never inject more than 50-100 cc. at a time through an ordinary Nelaton (Fig 66) catheter and prefer to use a rubber bulb syringe which can be easily sterilized by boiling and prevents using too much pressure in cases of contracted painful bladders.

A CERVICITIS can be treated at the same sitting without tiring the patient.

THE TREATMENT OF THE HUNNER ULCER has already been referred to. In obstruction of the vesical neck the same treatment is being used by Caulk and others as in median bar obstruction in the male.

TRICHOMONAS VAGINALIS INFECTIONS OF THE LOWER URINARY TRACT

It is beyond the scope of this chapter to discuss the diagnosis and treatment of this type of infection of the female genitalia. The urologist is however inter-

ested in its extension to the lower urinary tract. In a recent paper, Heckel (Jour Urol 1936, 35, 520) reports a study based on cystoscopic observation of 43 women suffering with *Trichomonas vaginalis* infection. The ages varied from 17 to 51 years. The following urinary symptoms were complained of in 37 of the 43 cases: frequency in 33, nocturia in 27, burning in 21, urgency in 10, dysuria in 8 and hematuria in 4. Cystoscopic lesions of the bladder or urethra were found in 24 of the 37 cases who had urinary symptoms. Even in five of the six in whom there were no symptoms, lesions in the bladder or urethra were found at cystoscopy. These lesions were limited almost entirely to the base, the mucosa appearing raised, fluffy and granular, at times areas resembling bullous edema (Plate II) were found at cystoscopy. The mucosa of the trigone is seen to be oedematous and granular with many minute hemorrhages. Similar changes occur in the urethra. Pyuria was present in 9 and microscopic hematuria in 6 cases. *Trichomonas* was only found in the urine of two and streptococci in the urine of 9 patients. The diagnosis was based on the history, the demonstration of *Trichomonas vaginalis* in the vaginal or urethral secretions and the above cystoscopic picture. Rapid improvement followed correct diagnosis and properly directed treatment.

INCONTINENCE OF URINE IN THE FEMALE

The terms 'false' and 'true' incontinence as used to designate the two types of involuntary passage of urine from the urethra in the male cannot very well be applied to the female. The term 'false incontinence' also called 'incontinence of retention' means the escape of urine at intervals from the urethra as the result of the overflow of a greatly distended bladder. This type exists in the female as in the male and the causes are the same viz., any form of mechanical occlusion of the bladder outlet or urethra or any type of neurogenic dysfunction (Chap. 28) which prevents the urine leaving the bladder or urethra. The term 'true incontinence' has been hitherto applied to all cases in which urine escaped through the urethra in small quantities from a partially filled bladder. Incontinence in the female may be due to a number of other causes than those located at the bladder neck, so that we consider it necessary to adopt a new classification for incontinence in the female by placing the causes into two groups, the vesical and extravesical, as follows:

VESICAL CAUSES

- 1 Defective innervation of the sphincter
- 2 Loss of support for the floor of the bladder resulting in various types of cystocele
- 3 Vesicovaginal and vesicocervical fistulae
- 4 Tumors, tuberculosis or advanced nonspecific cystitis
- 5 Ectopic ureter ending near the vesical outlet
- 6 A highly acid urine
- 7 Incontinence of purely functional origin

EXTRAVESICAL CAUSES

Urethral

- 1 Injury of urethra or loss of normal support as the result of parturition

- 2 Drag on the urethra by a cystocele
- 3 Deformity following gynecological operations
- 4 Atony or spasticity of the urethral sphincter
- 5 Diverticula strictures or tumors of the urethra.
- 6 Ectopic ureteral ending in the urethra.
- 7 Urethrovaginal fistulae
- 8 Epispadias and hypospadias

Vaginal and Vestibular Causes

- 1 Ectopic ureteral endings in the vagina or vestibule or both.
- 2 Ureterocervical and ureterovaginal fistulae

SYMPTOMS

The manner in which the incontinence appears in cases of ectopic ureteral endings and in the various types of fistula formations differs from that as seen in patients in whom the incontinence is the result of trauma due to parturition. In the ectopic ureteral ending cases if the orifice is in the vagina or vestibule the dribbling is most often continuous. If the orifice is in the urethra there is usually normal micturition with dribbling. We will describe the manner in which incontinence appears in the various types of urogenital fistulae in the next section.

In incontinence due to injury to the urethral or vesical sphincter or associated with cystocele the dribbling at first is only noticed on coughing, sneezing or laughing, hence only apt to occur during the day. Later the slightest increase of intra-abdominal pressure such as lifting, etc. is followed by escape of urine.

TREATMENT

Anatomy Before enumerating the various procedures employed at present for the surgical relief of incontinence in the female it is necessary to recall some points in the anatomy of the bladder and urethra which play an important part. In addition to the fixation provided by the ureters, cervix and urethra, the perivaginal fascia plays an important part as a support to the bladder base. In addition the perineal muscles also aid in the support. There are two sphincters, one an involuntary surrounding the vesical neck, and the other a voluntary around the urethra where it passes through the triangular ligament. There is still some difference of opinion as to the importance of this urethral sphincter. Bonney believes it plays but a small part in urinary control, whereas Johnstone (*Surg. Gynec. and Obst.* 1931: 53-97) and Crabtree (*loc. cit.*) believe that the urethral sphincter is an important factor in maintaining control.

The results of obstetric trauma may be placed in four groups: (a) those involving the trigone either at its apex or base; (b) those involving the sphincter urethrae; (c) weakening of the perivaginal and probably the perivesical fascia supports; and (d) damage to the perineal muscles. These injuries give rise to the two major defects of the parturient female bladder, i.e. descensus of the bladder as a whole and local protrusion of the trigone and whole bladder base according to Crabtree and co-workers (*loc. cit.*)

The treatment of incontinence due to ectopic ending of the ureter has been considered under anomalies of the ureter. The operative procedures which are being employed at present for the cure of incontinence in the female due to birth

trauma may be divided into two groups 1 plastics and suture of torn muscles
2 substitution procedures

1. Plastics and Suture of Torn Muscles

(A) THE KELLY OPERATION, i e, mattress suturing of the vesical neck and sphincter as modified by O Conor (Surg Clin North Amer, 1931, 11, 205)

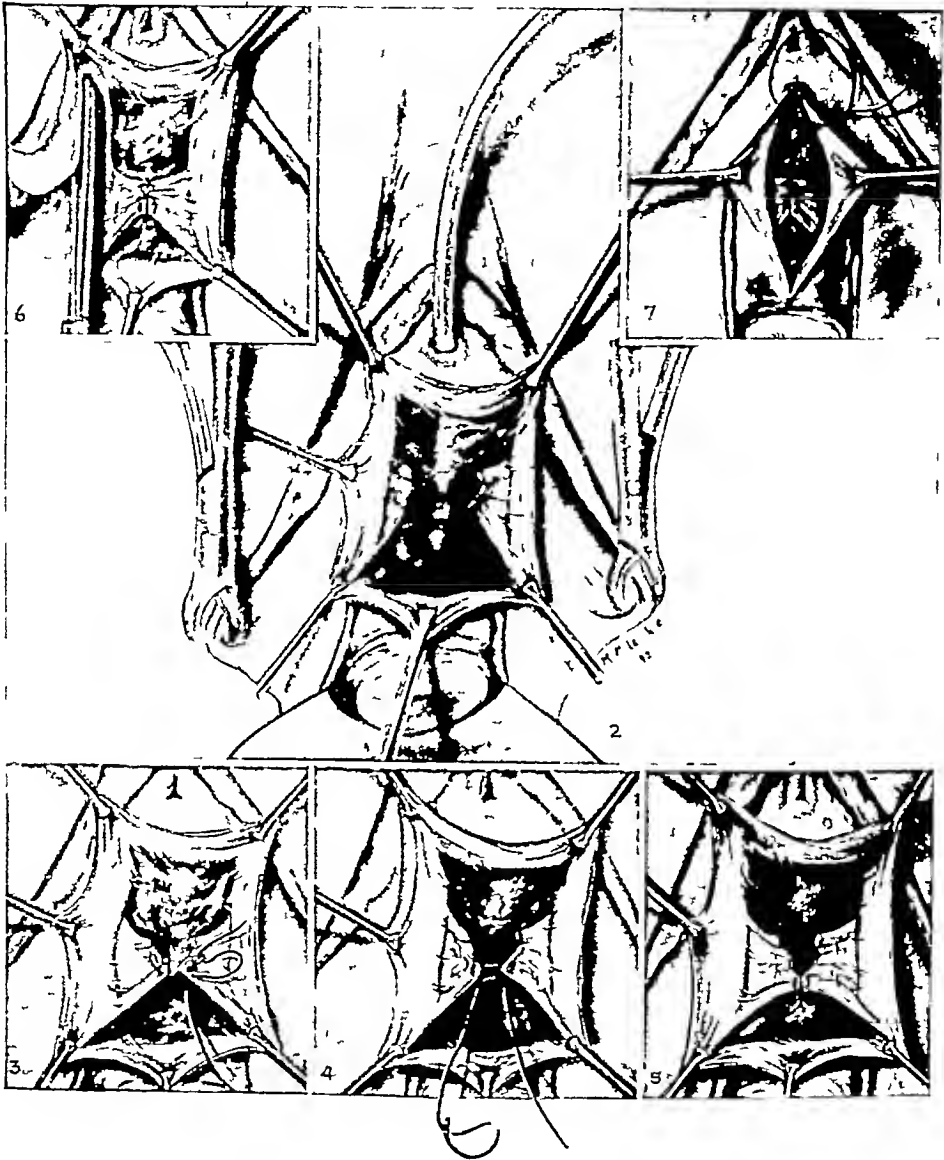


FIG 576—The Johnstone operation for incontinence of urine in the female The torn ends of the sphincter urethrae muscle isolated, 3 and 4 show stitch picking up the deep layer of the trigone and the torn muscle ends, 5 tying the first stitch, 6 completing the approximation and excising the redundant vaginal mucosa, 7 sewing up the vaginal mucosa

(B) THE JOHNSTONE OPERATION (Surg Gynec and Obst, 1931, 53, 97) which aims to approximate the torn edges of the urethral sphincter (Fig 576)

(C) THE DOUGLASS OPERATION (idem 1935, 61, 534) Mobilization of urethra then a first pursestring suture around the urethra and a second one nearer the vesical neck

All of these are combined with correction of coincident cystocele and perirenal tears

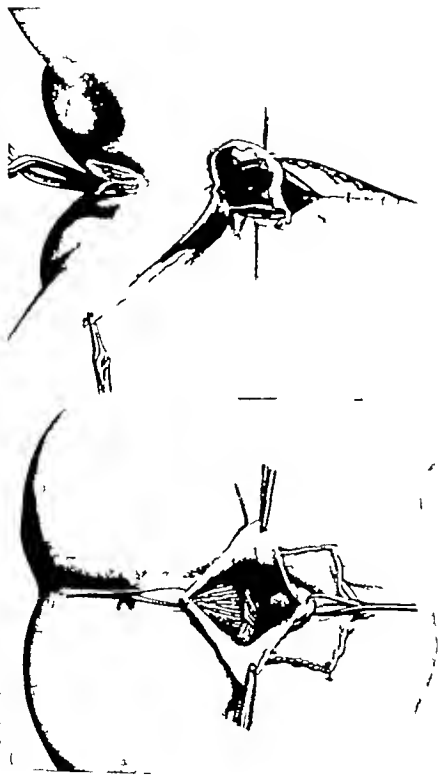


FIG. 577.—Goebell-Frangenkel technique for fecal continence of urine as modified by Stoedcl. The drawing on the left shows how the Pyramidalis muscle and the sheath of the Rectus abdominis are being pulled through a vaginal incision as suggested by Stoedcl. The drawing on the right shows the vesical neck is being encircled by the Pyramidalis and Rectus sheath through a separate vaginal incision. (Courtesy of Dr. W. Latsko of Vienna.)

2 Substitution Procedures

(A) OPERATIONS OF THE GOEBELL-FRANGENHEIM-STOECKEL TYPE Goebell (Zeit Gynak Urol, Vol 2, p 187) proposed to use the Pyramidalis muscle alone to form a vesical sphincter, but in his second case, found that it was necessary to also use the sheath of the Rectus abdominis Frangenheim (Zeit Urol Chir, 1922, 10, 190) utilized the sheath alone Both Goebell and Frangenheim attempted to only utilize a suprapubic incision, but Stoeckel (Zeit Gynak, 1921, 17) suggested in addition to an incision (Fig 577) designed to obtain the fascial strip and Pyramidalis to expose the urethra and vesical neck through a second incision (Fig 577) in order to be able to accurately encircle the vesical neck with the pedunculated muscle-fascia flap

LeFort and Schulz as well as Deming (Jour Amer Med Asso, 1927, 86, 882) have proposed the use of the Gracilis muscle to form a sphincter for the bladder Franz has suggested the use of the Levator Ani Latzko (Handb Urol, 1928, 5, 970) believes that none of the transplanted muscles or fascia serve any other purpose than to raise and thus give better support to the trigone

(B) THE USE OF RIBBON-CATGUT Lowsley (Jour Urol, 1936, 36, 400) reported the use of ribbon gut to form a sphincter If the urethra is very large and patulous, and the patient is entirely incontinent, only the ventral surface of the urethra is narrowed If, on the other hand, the patient merely loses a few drops of urine on coughing or other violent muscular activity, encircling the urethra with a piece of ribbon gut and tying it snugly, will be all that is necessary to effect a cure Animal experiments show that the ribbon gut is replaced by fibrous tissue

UROGENITAL FISTULAE

ETIOLOGY

Fistulous communication between the urinary and genital tracts may be due

1 To obstetrical trauma, the prolonged pressure of the head during a difficult delivery resulting in a necrosis of the intervening structures between the head and the bladder

2 Hysterectomy The sequel of a radical abdominal hysterectomy or of a vaginal hysterectomy, i e, postoperative

3 Radium Treatment The result of application of radium in the treatment of cancer of the cervix

4 Cancer The result of extension of a uterine cancer to the vesicovaginal septum, less often of a primary vesical cancer to the vagina

TYPES OF FISTULAE LOCATION OF ORIFICES

1 Vesicocervical Fistula The orifice is behind, i e, posterior to the trigone and may be minute or fairly large

2 Vesicocervicovaginal Fistula.

3 Vesicovaginal (Fig 578) Fistula This is the most common type and the orifice may be very high or opposite the trigone If very low, there may be a vesico-urethrovaginal fistula In postoperative vesicovaginal fistula, the orifice may be very high, in the retrotrigonal (Fig 41) area, i e, much higher than when the fistula is of obstetrical origin (Marion)

4 Vesico-ureterovaginal Fistula In this type, the opening in the ureter

communicates with the vesicovaginal fistula and is usually 2-4 cm above the vesical orifice of the ureter

As a rule there is only a single orifice which is round or oval, less often slit like. The orifice may be minute so that only a small amount of urine escapes, or it may be quite large. The average diameter of the orifice is 1 cm

Infection of the bladder and at times of the upper urinary tract is a frequent sequel of urogenital fistulae

SYMPTOMS

The chief complaint is the continuous dribbling of urine unless the opening lies very high, when the incontinence is very slight in the erect position. The only cause of incontinence which needs to be excluded is dribbling from an ectopic ureteral opening in the vagina. In the majority of cases the fistulous orifice in the bladder can be easily seen on cystoscopic examination. Ureteral fistulae differ clinically from vesical in the fact that in addition to constant dribbling from the vagina there is also voluntary micturition. The effect on the kidney of a ureteral fistula depends on whether infection exists and upon the resultant stricture formation. In the former case an ascending pyelonephritis will result. If stricture formation takes place the degree of hydronephrosis will depend on the extent to which the ureteral lumen is occluded.

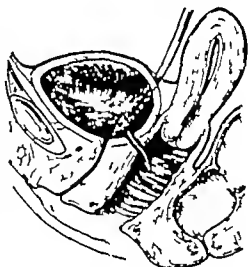


FIG. 578—Diagram of vesicovaginal fistula (See text.) The arrow indicates the fistulous communication between the bladder and vagina

DIAGNOSIS

History This will reveal whether (a) the escape of urine followed a few weeks after a difficult labor when the necrotic area was separated from the adjacent tissues (b) an operation (c) radium treatment.

Vaginal Examination. Digital examination may reveal the location of the orifice but it is better to instill an indicator such as mercurochrome or methylene blue into the bladder and observe with the aid of a vaginal speculum the escape of the colored urine into the vagina. If the fluid appears colored it obviously escapes through a vesicovaginal fistula. If colorless urine escapes the fistula is presumably ureterovaginal or ureterocervicovaginal the urine in the latter escaping directly through the cervical orifice of the uterus. After the colored solution injected into the bladder has been evacuated 5 cc. of 0.4 per cent solution of indigo carmin is given intravenously and the fistula observed with the aid of a vaginal speculum for escape of the blue tinged urine from the cervical canal or from the vaginal fornices. Unless the fistulous communication between the bladder and vagina is too large cystoscopy is possible and should always be done supplemented by ureteral catheterization and excretory urography. If an obstruction is found in one or both ureters. An obstruction to a ureteral catheter is not always a safe criterion if one suspects the presence of postoperative ureteral fistula, be-

cause compression of the lumen by scar tissue may offer resistance to the passage of the catheter

TREATMENT¹

The first principle is to institute preparatory treatment to overcome local infection, allow sloughs to separate and to restore local circulation

A Vesicovaginal Fistula Following Birth Trauma

If a vesicovaginal fistula occurs from obstetric injury, it is advisable to wait six or eight weeks before attempting a repair. Small fistulae from this source may heal spontaneously, providing a retention catheter has been employed to allow the bladder to be put to rest.

If the fistula persists, it should be repaired, utilizing the principles of (1) complete mobilization of the bladder from the uterine wall, (2) separate suturing of the bladder and vagina with inversion of the mucous membrane into such organ. If possible the suture line in the bladder wall and the vagina should not be directly opposite each other. This can be accomplished by attaching the bladder suture to the under side of the vaginal flap. (3) Suture material should be either fine chromicized catgut or silk for the bladder wall, and heavier chromicized catgut or silver wire for the vaginal mucous membrane. When the bladder opening is small, a purse string suture after freshening the margin to produce good coaptation, will be sufficient. A second row of fine chromic sutures supports the purse string stitches. If possible the fascia is repaired with interrupted chromicized sutures separate from the vaginal mucous membrane. A retention catheter should be used for at least ten days, and daily irrigations instituted to insure cleanliness and free flow. In the case of large fistulae, especially those which have been previously operated upon, one or more times, the large amount of scar tissue present may prove extremely troublesome, and complete bladder mobilization may be difficult. Transperitoneal repair may be required, or mobilization of the bladder by laparotomy as a preliminary step, to the vaginal repair. If the fistula is due to malignant disease, no attempt should be made to correct it unless the growth can be completely removed, a careful study is required in these cases to determine the relationship of the ureteral orifices before planning the operative procedure.

B Postoperative Vaginal Fistulae

Fistulae following total hysterectomy are as a rule small, and are usually located high in the vaginal vault, firmly fixed by scar tissue. Attempts to repair such fistulae by the vaginal route may not only result in failure, but often serve to increase the size of the opening. Kelly advises in such cases cutting across the scar posterior to the opening and incising the peritoneum. This permits the bladder to be pulled down through the opening, the defect to be closed by fine interrupted sutures, and covered over with peritoneum. When this is done it is advisable to drain the cul-de-sac for a few days in addition to using a retention catheter.

C Ureterovaginal and Ureterocervical Fistulae

If the ureters are severed during a difficult pelvic operation, it is Curtis' opinion that it is better to ligate the ureter than to attempt repair or transplantation, providing the kidney on the opposite side is found to be normal. If the kidney

¹ We are indebted to Dr. Irving F. Stein for this section on Treatment.

is found to be pathologic, or the pelvic operation has not been too severe transplantation of the ureter into the bladder is preferred, if it can be performed without creating too much tension. Curtis also utilizes the end to end anastomosis of the ureter over a fine catheter, with a second catheter placed in the ureter above the suture line emerging higher up through a slit in the ureter and a stab wound in the flank this may be removed in a few days. Spontaneous closure of post operative ureterovaginal fistulae has been observed, but it is followed by ureteral occlusion. If leakage persists however, either an attempt at ureteral repair or transplantation into the sigmoid may be required. The latter is usually done by the Coffey method which is sometimes the operation of choice as well in cases of extensive bladder defects.

Implantation of the ureter into the bladder or sigmoid is generally considered a more desirable operation than ligation of the ureter insofar as the latter entails the sacrifice of one kidney.

D. Vesicocervical and Vesicouterine

For the treatment of vesicocervical or vesicouterine fistulae the principle of bladder mobilization is definitely applicable. After separation of the bladder the opening in each organ is separately closed, the bladder with fine silk, and the uterus with chromic catgut. It is not necessary to completely close the uterine portion of the fistula but only that part nearest the bladder wall as the remainder will granulate. Laparotomy may be necessary for complete bladder separation in fistulae which are inaccessible but as a rule the vaginal approach is to be preferred.

Postoperative care is exceedingly important. The insistence upon a retention catheter for at least ten days, and utilization of prone posture for the first four or five days are useful in insuring primary closure of the bladder defect.

Antisepsis and free drainage are desirable both by urinary antiseptics and transvesical irrigation with mild antiseptic solution (boric).

Bed rest is required for from ten to fourteen days depending on the extent of the operative repair.

E. Vesicointestinal Fistula

These occur more frequently in men than in women according to most statistics although Cunningham in 342 collected cases found the opposite i.e. 75 per cent in women. Higgins (Jour Urol 1936 36, 694) reported 35 cases (21 in men and 14 in women) from the Cleveland clinic. Including these a total of 548 cases have been observed. The more frequent incidence of diverticulitis accounts for the higher percentage in men. Injury during parturition was responsible for the development of a fistula in 8 mothers. In 328 cases collected from the literature by Higgins trauma was the cause in 59 nonspecific and specific infections in 160 cancer in 91 and 18 were of congenital origin. The most common forms are (a) rectovesical and (b) rectosigmoid.

The passage of gas and feces through the urethra accompanied by the symptoms of a cystitis, is pathognomonic. The fistulous opening can usually be seen on cystoscopic examination as a small reddened ulcerated area surrounded by edematous mucosa. In some cases the communication can be visualized by cystography less often by barium enemas although the latter should be employed to aid the search for the underlying cause such as a carcinoma. The treatment is

palliative in a malignant condition that cannot be operated but radical if there is any prospect of cure by resection of the fistulous tract

UROLOGIC COMPLICATIONS OF GENITAL ORIGIN

CARCINOMA OF THE CERVIX

It is the consensus of opinion that every case should have a urologic examination made before treatment, whether it be operative or nonoperative, is begun. In every well-organized cancer hospital in which irradiation constitutes the sole method of treatment, the patients with cancer of the cervix are now being examined by a urologist before the treatment is begun, as well as during and after the same. Two recent papers, one by Aman-Jean (*Arch Mal Reins*, 1934, 8, 549) and the other by Graves, Kickham and Nathanson (*Jour Urol*, 1936, 36, 618), show the value of team-work by the gynecologist, the radiotherapist and the urologist. In addition, articles by Bugbee, Dean, Chauvin and others on the effects of radium will be cited.

Cystoscopic Picture Aman-Jean (*loc cit*) gives the results of 1000 cystoscopies at the Cancer Institute of the City of Paris during a five-year service as urologist. In his description of cystoscopic changes the classification adopted by the League of Nations and also by the American College of Surgeons is followed.

Group A, cancer confined to cervix,

Group B, cancer also involves the vaginal wall and uterine cavity,

Group C, cancer extends into broad ligaments,

Group D, wide pelvic extension and in some cases, remote metastases.

Aman-Jean found the following. In Group A, the most common picture before treatment is a smooth trigone with or without an accompanying hyperemia, in Group B, a granular cystitis with the mucosa presenting some ridges or localized bulging and very superficial furrows between the ridges. The left meatus is pulled upward toward three o'clock instead of being at seven o'clock and the right meatus is near six o'clock. Group C reveals the cystoscopic picture of a generalized edematous cystitis, the mammelated appearance of the trigone is especially striking, there being deep furrows between adjacent elevations. The displacement of the ureteral meatus is quite noticeable and the meatus are slit-like. In Group D, the bladder capacity is diminished, the urine turbid. The mucosa shows many ecchymoses and areas of bullous edema and the displacement of the ureteral meatus still more marked.

No mention is made in Aman-Jean's paper of the incidence of bladder complications in carcinoma of the cervix, but Graves and co-workers (*Surg Gynec and Obst*, 1936, 63, 785) found them in 209 of 683 cases which they studied. The cystoscopic picture is that of a quite localized bullous edema in the earliest stage followed by the appearance of a mass, sessile, dark red, with irregular surface and edges. The distortion of the trigone has already been referred to and may prevent ureteral catheterization.

In advanced cases of cancer of the cervix, the formation of a vesicovaginal fistula is not an infrequent complication.

Ureteral and Renal Complications These have been the subject of a number of recent articles. Graves, Kickham and Nathanson (*Jour Urol*, 1936,

36, 618) made a study of 257 cases of which 67 had a complete urologic examination and 87 others were observed at necropsy

Ureteral narrowing (evidenced by obstruction to the passage of a No 5 catheter) which varied from slight to complete, was encountered in 25 (37.3 per cent) of the 67 patients. The obstruction was unilateral in 16, bilateral in 9 and usually found 4-6 cm above the ureteral orifice. Ureterectasis and pyelactasis from a slight to advanced degree was found in 26 (81.3 per cent) of 32 patients when retrograde urography was used. The ectasis was unilateral in 17 and bilateral in 9. In 40 patients in whom excretory urography was employed, ectasis or absence of visualization was noted in 31 or 77.5 per cent. The necropsy examination of 87 cases revealed a hydronephrosis in 69 (79.3 per cent) the ureteral obstruction being unilateral in 23 and bilateral in 46. Ureteral occlusion is a frequent complication of cancer of the cervix which has invaded the broad ligaments.

Ureteral dilatation is of service if the occlusion is due to fibrosis and not to tumor invasion. otherwise nephrostomy or low iliac ureterostomy is the only means to prolonging life.

IRRADIATION OF THE UTERUS

These urologic complications may involve the bladder or the ureter.

Ulcer. Dean (Jour Amer Med Asso 1927 89 1123) was the first to call attention to ulceration of the bladder after applications of radium to the uterus. In the discussion of this paper similar cases were reported by Keyes, Beer, Bandler and Smith. In a second report Dean (Jour Urol 1933 29 559) states that 47 additional cases have been observed. Chauvin (Arch Mal des Reins, 1935, 9 641) reported 2 personal cases occurring 1½ and 2 years after radiation and collected 17 others including the 3 reported by Dean in 1927 making with the latter's 47 cases (loc. cit.) a total of 66 cases.

In Dean's last 47 cases both radium and the roentgen rays had been used the more intense radiation by the former. The uterine diseases included both benign and malignant conditions. The bladder symptoms appeared on an average two and a half years after the radiation. The usual sequence of symptoms was frequency, dysuria and hematuria (in about half). Cystoscopic examination either revealed a single round ulcer with intensely red periphery or acute inflammation with deep red spots of punctate hemorrhage. The lesion was situated in the posterior third of the bladder base in or near the midline. The prognosis is bad if the ulceration is extensive. There is danger of a vesicovaginal fistula or of very severe bleeding. Treatment includes Tr Hyoscynamus and codeine for pain, dilute phosphoric acid both by mouth and for bladder lavage and instillations of argyrol and mercurochrome.

Ureteral occlusion following radiation for diseases of the uterus is a subject which is being actively studied at present by both gynecologists and urologists. A report of 8 cases, of which 6 required nephrectomy by Bugbee (Jour Urol., 1934 32 439) is of much interest. The radiation had been employed in the treatment of cancer of the cervix in all of the 8 cases. An advanced degree of pyonephrosis existed in the six cases in which the kidney was removed. The interval between appearance of symptoms of ureteral occlusion and the radiation treatment varied from 22 months to 9 years. The ureteral obstruction was unilateral in 7 cases and bilateral in 1. the average distance from the ureteral orifice

was 4 cm and in 3 cases there was a ureterovaginal fistula distal to this point In 2 cases carcinoma was found at necropsy to have extended into or metastasized in the ureter Bugbee advises that urinary examinations should be made regularly after irradiation and be supplemented by excretory urograms and cystoscopy, when symptoms or physical signs suggest the possibility of ureteral occlusion

RENAL INFECTION IN PREGNANCY AND THE PUERPERIUM

Etiology Stasis in any portion of the urinary tract is the most important predisposing cause of infection The dilatation of the ureter and renal pelvis incident to normal pregnancy provides this predisposing cause The bacteriology, pathologic changes and clinical pictures of renal infection in pregnancy do not differ from those of the same condition as observed in the male and the nonpregnant female The differences in treatment are those which arise from the presence

of the fetus, i e, whether or not the pregnancy shall be terminated

Dilatation The incidence of upper urinary tract dilatation in pregnancy and the puerperium has been the subject of a number of recent articles Duncan and Seng (*Amer Jour Obst and Gynec*, 1928, 16, 557) used retrograde urography and found that dilatation began in multiparas as early as the sixth and in primiparas as early as the tenth week In the former, the



FIG 570—Cystogram in seventh month of pregnancy showing how bladder is flattened in its transverse diameter by fetal head (Dr J E Lackner's case)

maximum is reached by the twenty-second and in the latter by the twenty-fourth week, then continued unchanged in both primipara and multipara throughout the remainder of the pregnancy The right ureter and renal pelvis were involved in all but the left in only 71 per cent of the cases A majority returned to the normal non-pregnant condition by the ninth day but some of their cases showed dilatation of the upper urinary tract for a long time

The study of changes in the upper urinary tract in pregnancy and the puerperium has been greatly simplified since the introduction of excretory urography Crabtree and Prather, Cornell and Warfield, Baird, Carreras and Figueras, Schumacher found some degree of dilatation of the upper urinary tract in every pregnancy, 100 per cent on the right, 70-85 per cent on the left side The right tended to be dilated more than the left side Lee and Mengert (*Am Jour Obst and Gynec*, 1932, 24, 205) used excretory urography in the examination of 41 normal pregnant women, 20 primiparas and 21 multiparas All showed some degree of right and the majority, of left sided dilatation More primiparas than multiparas had antepartum dilatation and the involution was slower postpartum Involution was complete in the majority of 12 normal patients by the ninth to twelfth day and most of the 41 patients showed marked reduction in the caliber of the urinary tract by the end of the twelfth day postpartum Kretschmer, Heaney and Ockuly (*Jour Amer Med Asso*, 1933, 101, 2025) employed excretory urography in the examination of women with negative (bacteriologic and cystologic) urine and free from obstetrical complications Their results were divided as follows

First period (2-5 months) 54 cases Dilatation in 67 per cent, both sides in

37 per cent right alone 28.3 per cent left alone 17 per cent. The earliest case (2 months) showed right sided dilatation only

Second period (6-9 months) 44 cases Dilatation in 93 per cent both sides in 54.7 per cent right side alone 38.3 per cent left alone 0 per cent

Third period (first 2 weeks postpartum) 32 cases Return to normal in 2 weeks in 59.4 per cent to normal in 6 weeks in 34.4 per cent and after 12 weeks in 6.25 per cent.

These studies show that dilatation of the upper urinary tract is an almost constant coincident condition

ORIGIN OF DILATATION There is sufficient evidence at hand to show that dilatation of the ureter and renal pelvis is found in all normal pregnancies and that recession takes place within six weeks in the large majority of cases. As to whether this dilatation is of mechanical or dynamic origin there are three schools," if one may employ this term to designate the different viewpoints at the present time

1 **MECHANICAL** Those who believe that ureteral obstruction of mechanical origin is responsible for the upper urinary tract dilatation. Hofbauer as the result of histologic examination of ureters taken from women dying during pregnancy is of the opinion that hypertrophy and hyperplasia of muscle and fibrous tissue of the ureter and periureteral sheath are the source of the obstruction. Others believe that it is due to pressure between the enlarging uterus and the brim of the bony pelvis or belly of the psoas muscle (Schumacher). If pressure from the enlarging uterus were responsible for the dilatation one would not expect to see it begin at the sixth to tenth week at a time when the uterus is still a pelvic organ according to those who oppose the mechanical obstruction theory. One would expect to see increasing dilatation as the uterus becomes heavier and larger. In stead of the actual finding that the dilatation reaches its maximum from the twenty-second to the twenty fourth week and then remains stationary. In order to determine whether or not actual obstruction existed in that portion not visualized by excretory urography Lee and Mengert (*loc. cit.*) made retrograde urograms on ten pregnant women but failed to find any evidence of pressure on the ureter from adjacent structures.

2 **MUSCULAR ATONY** The second school includes those who believe that the dilatation is the result of the action of either hormones or of toxins on the ureteral and renal pelvic musculature with resultant atony. Sellheim and others are warm supporters of the hormone and Stoeckel of the toxin theory

3 **MIXED** The third school is of the opinion that the dilatation is of "mixed" origin viz. that the chief factor is the atony of the musculature and that compression by the uterus is a secondary cause

It is evident from the preceding discussion that (a) dilatation of the upper urinary tract occurs in every normal pregnancy and (b) that it is of only short duration in normal cases, during the puerperium. The stasis incident to this dilatation as stated above, is an important predisposing cause in the production of upper urinary tract infection not only during pregnancy but also during the puerperium. If the infection persists from one pregnancy to successive ones, the dilatation which is both the predisposing cause and the effect of infection can be easily discovered by our present methods of examination. In the patient whose urogram is shown in Fig. 580 the dilatation of the upper tract was still demon-

strable 18 months after delivery, being accompanied by pyuria and other signs of chronic infection of the ureter and renal pelvis. In addition to "flare-up," i.e., exacerbations of the infection in subsequent pregnancies, another factor to be especially taken into consideration both in taking the history of a case of renal infection in pregnancy and in the puerperium as well as in its diagnosis is the persistence of a pyelonephritis occurring during infancy and childhood.

The bacteriology of renal infection in pregnancy and puerperium does not differ from that at other periods (see Chap. 39). In the majority of cases, bacteria of the *B. Coli* group are found. Whether they have been preceded by coccal infection, it is impossible to determine as a rule. That the hematogenous mode of invasion is relatively frequent is shown by the fact that in most cases, bladder changes indicative of infection are comparatively rare.

Clinical Pictures. Cases of renal infection in pregnancy and the puerperium are encountered under one of the following forms:

1. AS LATENT CASES in which the examination of the urine as a part of prenatal care reveals the presence of a pyuria, whose source is found to be from one or both kidneys.

2. AS CASES WITH MILD SYMPTOMS OF RENAL INFECTION, in the form of frequency, and dysuria accompanied by pyuria. Urological examination shows evidences of a mild cystitis with edema (Plate II) of one or both ureteral orifices and the presence of a large number of pus cells and bacteria in the urine obtained by ureteral catheterization from one or both kidneys.

In order not to overlook the existence of a more serious involvement of the kidneys than that incident to a mild degree of chronic pyelonephritis or a ureteral or renal calculus as a

complication of the infection, it is advisable to routinely have a plain film made and to employ excretory urography. Although the latter method is not ideal for the detection of finer caliceal changes, it gives sufficient visualization upon which to base a diagnosis of the degree of dilatation of the upper urinary tract and thus to ascertain the effect of the infection on the renal parenchyma.

3. AS CASES OF ACUTE, ALMOST FULMINANT, GENERALIZED SYMPTOMS, such as high temperature of the remittent type preceded or not by chills (Fig. 581). In

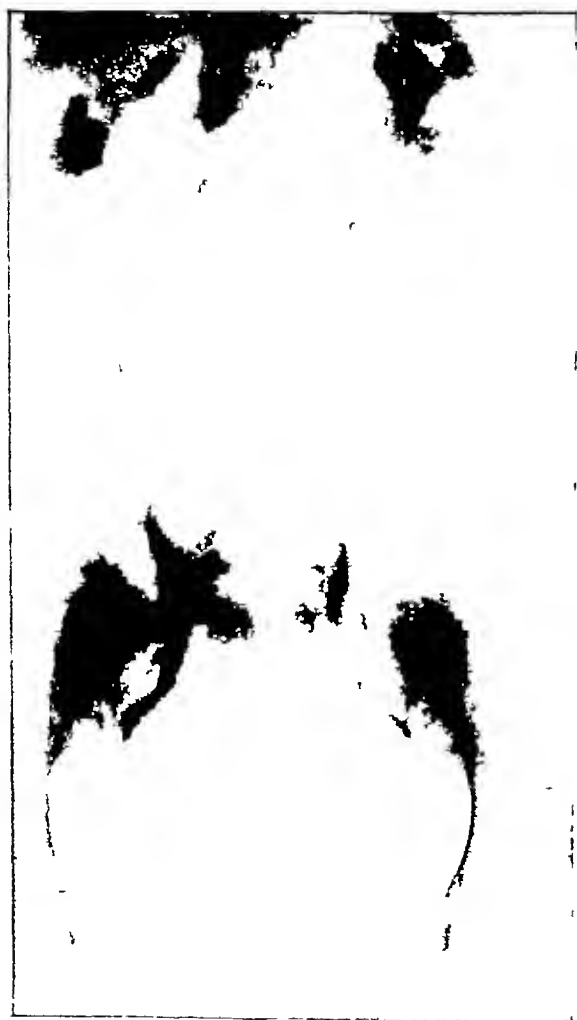


FIG. 580—Pneumograms from bilateral pyelonephritis with symptoms during first pregnancy and with recrudescence during puerperium. Note persistence of dilatation of both renal pelvis and especially of right ureter, one year after cessation of pregnancy.

addition to the fever all of the other symptoms of severe pyelonephritis described on page 700 may be present. In some patients there are a few localizing signs pointing to the kidney as the source of the symptoms in the form of pain or tenderness on palpation and enlargement of the kidney unless the reflex muscular rigidity prevents the discovery of these two last named symptoms. In other patients, the acute onset is not accompanied by any such localizing signs and a differential diagnosis must be made from generalized sepsis pneumonia acute miliary tuberculosis and acute blocking of the ureter or kidney by a calculus. During the puerperium in the absence of localizing signs pointing to the kidney acute renal infection may be wrongly diagnosed as some form of puerperal sepsis. This was the first thought in a case referred to one of us in which the gynecologist failed to find any cause for the clinical picture of acute sepsis (Fig. 581) in the genital tract. W. E. Stevens states that the first symptoms of renal infection only

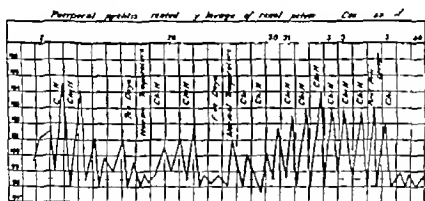


FIG. 581.—Chart from severe pyelonephritis of the puerperium without localizing signs (see text). Note recurrent cycles of chills, fever, etc., which subsided after second lavage of the renal pelvis. This case was seen before indwelling ureteral catheter was employed as is the custom at present in such severe infections.

appear in the puerperium in 18 per cent of the cases having remained latent during the pregnancy.

Diagnosis. In the latent group of cases it is usually the presence of a pyuria which leads to the examination of the urinary tract. The various steps to follow in localizing the source of the pyuria have been given in Chap. 47. In the mild pyelonephritis group the salient symptoms are those of a cystitis. If these do not improve under medical and local (vesical instillation or lavage) treatment further examination as to the condition of the upper urinary tract is indicated especially for an incipient renal tuberculosis the symptoms of which may appear for the first time in pregnancy. The coincidence of a uretero- or nephrolithiasis which has been latent should always be excluded.

As to the acute cases without localizing signs pointing to the kidney as the source of the symptoms the possibility of an acute pyelonephritis syndrome must always be kept in mind when high temperature and other symptoms of severe bacteremia suddenly appear in pregnancy and the puerperium.

No time should be lost in making a urologic examination consisting in the order named of plain radiography excretory urography and ureteral catheterization. In many of these cases there is a history of similar attacks in childhood or in previous pregnancies. In all of these acute cases without localizing signs

other conditions, mentioned under symptoms, which can give rise to similar clinical pictures must be excluded

In the acute cases with localizing signs, the principal lesions which require to be excluded are acute ureteral or renal block by a calculus (Chap 42) and perinephritic abscess (Chap 40)

Treatment This does not differ in principle from that outlined in Chap 39 for acute and chronic pyelonephritis. Forced fluids, the administration of alkalies and rest in bed suffice for most of the mild cases. If they prove resistant to such conservative measures, a urological examination to search for sources of obstruction or stasis other than those incident to pregnancy must be sought. If pyuria persists after a pregnancy, the patient should receive the same treatment as one would give in non-pregnant cases, until three examinations of the ureteral urines show sterile cultures and absence of any abnormal cytological elements. For the acute cases, the use of the inlying ureteral catheter (Fig 488) should be given a prolonged trial without any attempt to inject any solutions into the renal pelvis. In order to prevent overlooking the presence of a calculus in the ureter or renal pelvis, it is advisable to have a plain film made, with the catheter in situ.

The best method to keep a check on the benefit of drainage through and alongside the inlying ureteral catheter, is by daily blood cultures, best taken following a chill. If these continue to be positive and there is no improvement in the clinical picture, operative measures must be considered. Whether to simply do a nephrostomy or to remove the infected kidney has been discussed in Chapter 45. At the present time, induction of labor is rarely necessary if these cases of acute renal infection are recognized early enough and the use of the inlying ureteral catheter not delayed until its efficacy is questionable. Every prenatal clinic and obstetric department of a general hospital should have a urological service for early detection and treatment of renal infections.

FEMALE PSEUDOHERMAPHRODISM

Young (Monograph on Genital Abnormalities, 1937, Williams and Wilkins Co) gives the histories of four female pseudohermaphrodites observed by him. All of these cases presented identical conditions:

- 1 Greatly enlarged adrenals with hyperplasia of the androgenic or prenatal zone of the cortex
- 2 Hypoplastic or infantile ovaries with multiple cysts, probably resulting from the repressive influence of the adrenal hyperplasia
- 3 An enlarged clitoris, a persistent urogenital sinus, so that the vagina opened into the urethra

In one of Young's cases, the child was only four years of age, and yet there was evidence of considerable overgrowth. A portion of each hyperplastic adrenal was resected and plastic operations carried out to amputate the enlarged clitoris, bring the vagina down to the perineum and produce a female vulva.

In a second case, the patient had passed puberty. Marked virilism with a pronounced beard, amenorrhea, undeveloped breasts, narrow hips and general masculine aspect, were present.

In two other cases, one a sister of the second patient and another, four years

of age in whom marked masculinization was present similar operative procedures were done. The operations have been uniformly successful.

These cases are examples of the adrenogenital syndrome beginning in fetal life in females and resulting in hermaphroditism, characterized as a rule by failure of the ovaries to develop and stimulate the formation of the external genitalia. The four cases reported by Young are the first in which not only partial adrenalectomy but also vaginal and clitoris plastic procedures have been employed in childhood.

CHAPTER 46

UROLOGY IN CHILDREN

METHODS OF UROLOGIC EXAMINATION	DIAGNOSIS
LOWER URINARY TRACT OBSTRUCTION	TREATMENT
THE ROLE OF ANOMALIES	TUBERCULOSIS
EFFECTS OF LOWER TRACT OBSTRUCTION	UROGENITAL
CLINICAL PICTURES	URETER, BLADDER AND URETHRA
DIAGNOSIS	MALE GENITALIA
TREATMENT	UROLITHIASIS
UPPER URINARY TRACT OBSTRUCTION	NEOPLASMS OF THE UROGENITAL TRACT
THE ROLE OF ANOMALIES	KIDNEY
CLINICAL PICTURES	BLADDER
DIAGNOSIS AND TREATMENT	PENIS AND URETHRA
NEUROMUSCULAR DYSFUNCTIONS OF THE URINARY TRACT	TESTIS
PATHOLOGIC AND CLINICAL PICTURE	PROSTATE
ETIOLOGY	ADRENAL
RENAL INFECTION IN CHILDREN	GONORRHEA IN CHILDREN
PREDISPOSING CAUSES	BOYS
CLINICAL PICTURES	GIRLS
	ENURESIS

METHODS OF UROLOGIC EXAMINATION

The successive steps as outlined in Chapter 10 apply equally well to the examination of infants and children with relatively few modifications, as follows

A The clinical history in children must in most cases be obtained from the parents or those who have had charge of the child, the line of questioning to be followed is given in Chapter 10

B The general physical examination in children, in addition to the suggestions made previously, should be especially directed to the search for foci of tuberculous and nontuberculous infection in the lymph-nodes, bones, joints and extrarenal abdominal viscera

C The local examination should begin with inspection and palpation of the abdomen for enlargement in the kidney region by the bimanual method. One must always keep in mind an ectopic position of the kidney of congenital origin. Next, attention should be paid to search for any suprapubic enlargement (Fig 173) due to a distended bladder.

EXAMINATION OF THE EXTERNAL GENITALIA must include

(a) Search for the various anomalies of the urethra and bladder to be enumerated below

(b) Palpation of the scrotum and inguinal region for undescended or abnormally located testis

(c) Palpation for hydrocele, enlargements of testis and epididymis as well as of the vas deferens

(d) In cases of incontinence, search for the orifice of an ectopically ending ureter in the vestibule or vagina

RECTAL EXAMINATION should always be included in the search for abscess of the prostate and for sarcoma of the prostate if there is considerable distension of the bladder or the history of frequency or difficult urination

D The Urine The search for abnormal cellular content as well as the chemical and bacteriological examination does not differ from that employed in adults. The only difficulty is in obtaining the specimen. In older boys, when there

is no history pointing to some form of urethral or vesical neck obstruction the voided urine can be utilized. In girls, especially if there is a vaginal discharge, it is advisable to catheterize using a very small soft rubber catheter. For infants a test tube can be fastened with adhesive plaster over the penis or over the urethral meatus in girl babies. The 24-hour output during the first year is 500 cc. between the first and fifth years, 500-700 cc. and it then rises to 1400 cc. by the fourteenth year.

For the determination of renal function in children, we employ the tests outlined in Chap. 8.

E. Radiography in children differs in the following respects:

(A) For CYSTOGRAPHY, only 50 cc. of the opaque medium for babies (up to one year) and only 100 cc. for children up to 8-10 years should be employed.

(B) EXCRETORY UROGRAPHY in general, is only indicated if the retrograde method is contraindicated. Campbell (Pediatric Urology, Vol. I, p. 106) who has

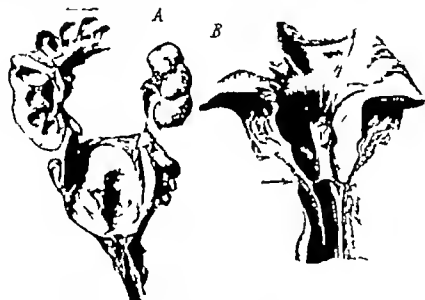


FIG. 582.—Case of congenital stenosis of the posterior urethra reported by C. R. Wilkens (Zeit. für Urol., 4, 819).

A. Marked dilatation of the bladder and of the upper urinary tract proximal to the obstruction.

B. Close up view of urethra at point of valve formation. The mucosal folds almost completely occluded the lumen.

used the method in a large number of children, found that poor shadows, i.e. of unsatisfactory clarity may lead to an inaccurate diagnosis and are observed in tuberculosis, neoplasm, solitary cysts, polycystic disease and pyelonephritis.

For children up to three years the doses are one third to one half and up to the age of eight years one-half to four fifths of the adult dose.

(C) For ASCENDING (RETROGRADE) UROGRAPHY (Chap. 7) the syringe method is the most satisfactory. Bilateral urography presents no additional risks if a 20 per cent solution of the intravenous media is used and only one kidney is injected. A film exposed and the second one injected while the first film is being developed so that the opaque medium in the first injected kidney has had time to be expelled. Not more than 5 cc. for children 5 years old should be injected and immediately discontinued if any resistance is felt. Smaller quantities 2-3 cc.

suffice for infants. If both catheters are withdrawn and a third exposure made, it is often possible to visualize the entire length of both ureters (Fig 145)

F. Cystoscopy and Ureteral Catheterization These should be done in cases of acute bladder or upper urinary tract except for therapeutic purposes, such as the insertion of a ureteral catheter for drainage purposes (see later). Local anesthesia suffices for older children (8-10 years) but in younger, general anesthesia is advisable as a rule.

It is necessary to use cystoscopes of very small caliber. The first one was that of Beer, then that of Butterfield which was modified in 1929 so as to have a removable telescope, and although the sheath only had a caliber of 15.5 F, two 4 F ureteral catheters could be employed. Young and Campbell (Fig 120) have also devised cystoscopes for use in children.

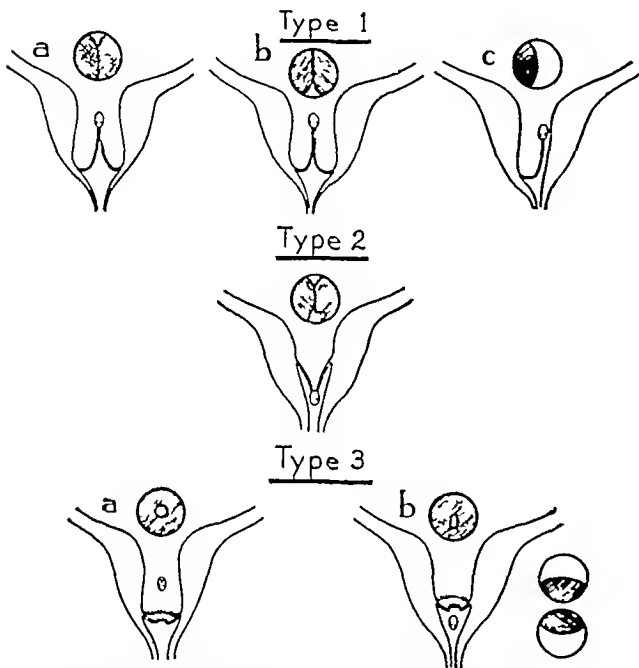


FIG 583—A diagram showing the three types of congenital valves of the posterior urethra. Type 1 a, Two bifurcated valves springing from distal portion of verumontanum b, Two fused valves in same position c, A unilateral valve in same position. Type 2 a, A bifurcated valve extending from proximal portion of verumontanum to lateral sides of prostatic urethra and roof. Type 3 a, Iris valve below verumontanum b, Iris valve above verumontanum. The shaded circles represent the cystoscopic field seen in the region of valve. The internal sphincter and the prostatic urethra are shown to be dilated and the region of the membranous urethra is indicated. (Courtesy of Drs Young and McKay and of Surgery, Gynecology and Obstetrics.)

LOWER URINARY TRACT OBSTRUCTION

THE ROLE OF ANOMALIES

The clinical aspects of lower urinary tract obstruction, whether due to one type of anomaly or another, have so many features in common that we will consider them together.

Lower urinary tract obstruction is the result of one or a combination of the following anomalies:

- 1 A very small opening in the prepuce
- 2 Stenosis of the external meatus of the urethra
- 3 Stricture of the urethra
- 4 Diverticula of the urethra
- 5 Valve formation in the posterior urethra (Figs 582, 583, and 584)
- 6 Hypertrophy of the verumontanum

7 Contracture of the vesical neck (Fig 586)

8 Blocking of the bladder outlet by a ureterocele or diverticulum

The first four types of anomaly are discussed in Chapter 17 and the last-named in Chapter 17. We will describe the others here.

Congenital Valves of the Posterior Urethra These are folds of the mucosa which cause obstruction to the passage of urine through the prostatic portion of the urethra. Up to 1912, only 22 cases had been observed at necropsy, the

first clinical case being that of Young who recognized the presence of this anomaly during cystoscopic examination of a boy 17 years of age who had complained of difficulty in urinating since birth.

Up to the present (1937) time, 166 cases have been observed including the 21 necropsy reports, prior to the first clinical diagnosis by Young. One of us (Rolnick) has observed the anomaly in twins (Fig. 584).

THERE ARE THREE TYPES OR FORMATIONS according to Young. IN TYPE 1, which is the most common, there is a ridge lying on the floor of the urethra continuous with the verumontanum which takes an anterior course and divides into two forklike processes (Fig. 583) which may be attached to the urethra through out its circumference. In the majority, the fusion of the valves is incomplete but it may be complete or there may be only a single instead of a double. IN TYPE 2, the more or less cylindrical ridge passes over the upper aspect of the verumontanum toward the internal sphincter. Here it divides into two similar forklike processes which are continued as membranous sheets and are attached to the urethra just outside the internal sphincter. TYPE 3 bears no relation to the verumontanum but forms a sort of iris-like valve whose edges are attached to the circumference of the urethra with an opening in the center.

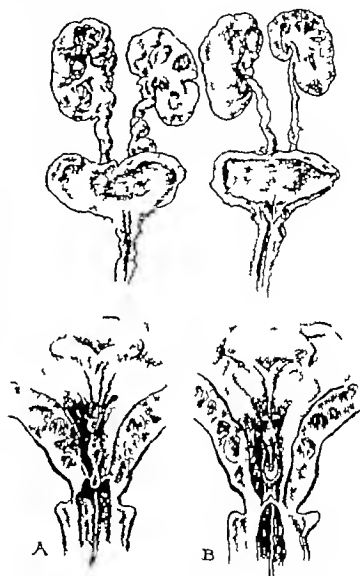


FIG. 584.—Congenital valve formation of the posterior urethra in twins. (Type 1) Compare with Figs. 583 and 583.

Congenital Hypertrophy of the Verumontanum. Eight cases of this form of urethral anomaly were reported in 1923 by Bugbee and Wollstein. A number have been observed since that date. At urethroscopy the verumontanum is seen to be greatly enlarged almost filling the posterior urethra.

Congenital Contracture of the Vesical Neck (Figs. 585 and 586). This cause of chronic retention of urine in children was first described by Beer in 1915 whose observations led to the belief that the secondary fibrosis in a spastic sphincter is due to a disease of the neuromuscular apparatus. Histologically the condition is characterized by a submucous fibrosis which may involve the entire

circumference of the vesical outlet or only a portion of it and is accompanied as



FIG 585—Dilated bladder of child with advanced degree of reflux in both ureters and renal pelvis with extreme degree of dilatation of upper urinary tract (Courtesy of Dr Edwin Beer)

a rule by hypertrophy of the trigonal muscle (Fig 243) It is most commonly observed in boys rarely in girls Its occurrence in twins has been reported by Wilhelm

EFFECTS OF THE LOWER TRACT OBSTRUCTION

At first the bladder musculature hypertrophies to compensate for the increased resistance to the expulsion of urine This is followed by a period of decompensation in which there is either complete retention or the child voids with great difficulty aided by the abdominal muscles and diaphragm In this stage of incomplete emptying of the bladder, the residual urine favors the localization of bacteria If the various types of obstruction in the urethra and vesical neck are not relieved, the resultant back pressure is followed by incompetency of the ureterovesical mechanism which under normal conditions, prevents reflux of bladder contents into the ureter during micturition The ureteral orifices gape and allow the back pressure to be exerted on the ureters and renal pelvis (Figs 591 and 593) The effect on the kidney parenchyma varies according to whether there is a coincident infection or not In the former case, the pathologic changes are those of an ascending pyelonephritis (Plate XI) If no infection exists a hydronephrosis results



FIG 586—Chronic retention of urine in a child Cystogram showing large bladder (Courtesy of Dr Edwin Beer)

The systemic effects are those due to retention of nitrogenous end products alone or combined with those resulting from the acute or chronic pyelonephritis accompanying the back pressure on the renal parenchyma

CLINICAL PICTURES

Children with lower urinary tract obstruction present one of two clinical pictures

1 The symptoms due to the obstruction and its effects predominate

2 The symptoms of a concomitant infection predominate

1 Symptoms of Obstruction and Its Effects Predominate The chief complaint, as elicited from the parents, is difficulty in voiding which has existed since birth. The child was obliged to try to urinate oftener than other children and when he or she did so, the stream was usually small with a tendency toward dribbling. At times when the retention is complete incontinence is complained of and if it occurs at night may be mistaken for enuresis. This incontinence simply represents the overflow of a distended bladder. Beer states that, in some cases the child seems to pass a good stream but one finds as evidence of chronic retention, a suprapubic mass (Fig 173) corresponding to the distended bladder.

THE URINE IS CLEAR AND NEGATIVE so far as cytologic and chemical changes are concerned until infection supervenes.

THE GENERAL SYMPTOMS reflect the degree of interference with the function of the kidneys as the result of the back pressure from the lower urinary tract. In mild cases of nitrogen retention in the blood the child appears pale tires easily, has a poor appetite and often complains of headache. If the retention of urine is of long standing there is a history of headaches, nausea or vomiting and loss of weight, which may terminate in convulsions, coma and death. Estimation of the urea content of the blood is the best method of judging the relation of the symptoms of chronic uremia as outlined to the degree of destruction of the renal parenchyma by pressure atrophy.

2 Symptoms of a Concomitant Infection Predominate. In this group can be placed the children who present all of the symptoms of an acute renal infection with or without localizing signs as described in Chapter 39 or whom the urologist is asked to examine because of a pyuria which has resisted all medical treatment. In the latter subgroup there may be a history of recurrent acute attacks which were diagnosed as cystitis or pyelitis. It is only after an examination



FIG 58.—Cystogram from case of congenital valves of the posterior urethra showing distended bladder, dilated prostatic urethra, bilateral hydronephrosis and hydro-ureter. Suprapubic cystotomy with destruction of valves. (Courtesy of Drs. Young and McKay and of Surgery, Gynecology and Obstetrics.)

has been made and a distended bladder found on abdominal palpation, that further search will reveal a urethral or vesical neck obstruction as the underlying cause of the renal infection

DIAGNOSIS

This depends upon the interpretation of the clinical history and the urologic examination

The history of difficult urination with periods of frequency or of incontinence should at once direct attention to the bladder or urethra as the source of the symptoms. If, however, difficulty of urination is not a salient feature of the clinical history and one is only told that there have been recurrent attacks resembling a cystitis or pyelitis, or a persistent pyuria, a lower urinary tract obstruction will not be thought of until the child is examined

Abdominal examination will usually reveal the presence of a suprapubic mass corresponding to the distended bladder (Fig 173). In some cases, the enlarged ureters and kidneys are easily to be outlined by palpation. The examination of the external genitalia should include inspection of the prepuce for pin-point meatus and of the external meatus for stenosis

The bladder should never be emptied too rapidly. It is advisable to pass a small soft rubber or, even better, a ureteral catheter and decompress the bladder slowly as in prostatics. One should be guided as to the time for further study by the results of the blood chemistry, the drop in temperature in infected cases and the improvement in the general condition of the child

Urography A plain film is first taken to exclude calculi, then excretory urography is used to give information as to the degree of upper tract dilatation and whether absence of visualization on one or both sides indicates an advanced degree of renal damage. The next step is to do a cystography to ascertain the size of the bladder, the presence of diverticula and whether a reflux into the upper urinary tract (Figs 585 and 587) exists. It is advisable, as a rule, to wait a few days before attempting instrumental examination of the urethra and bladder. In posterior urethral valve obstruction these can be easily distended by manipulation of the irrigating current during urethrocystoscopy and seen to be ballooned into cusps like those of the heart (Campbell). Cystoscopy will reveal the degree of trabeculation (Plate VIII), presence of diverticular orifices (Plate VIII), calculi (Plate VIII) and the intensity of a coincident infection

In congenital contracture, the cystoscope encounters resistance at the vesical neck. The typical finding in children resembles that of adults, viz, a transverse ridge or bar (Fig 245) passing across the lower half of the vesical orifice. In some cases, there is a circular, collar-like intrusion of the entire sphincter involved

TREATMENT

This varies according to the type of anomaly which has given rise to the lower urinary tract obstruction

For pin-point opening in the prepuce, one should be content with simple dilatation by spreading the blades of an artery forceps until the condition of the child improves sufficiently to allow a circumcision to be done

In stenosis of the meatus, meatotomy (See Chap XLVIII) suffices, but the orifice may need to be dilated from time to time with small straight sounds like those used in females (Fig 80)

The treatment of congenital stricture a rare type of anomaly does not differ in principle from that of the acquired variety in adults. The safe rule to follow in children as in older patients is to begin with filiforms advance with the various forms of wax silk bougies or follow up sounds, of very small size until a very large caliber can be easily passed in a child, e.g. 18-20 F. One should never try to force an instrument and never advance too rapidly in the attempt to pass larger calibered ones.

Operations. Clinically, these children with lower urinary tract obstruction are seen under the same conditions as adults suffering from retention due to urethral stricture or one of the various types of bladder neck obstructions described in Chapter 18. No operative measures should be undertaken until complete decompression has been obtained, the blood urea is approximately normal and the general condition of the child has improved greatly. If it is impossible to catheterize, a suprapubic cystostomy for temporary drainage is advisable.

When it is impossible to pass any instrument through the urethra an attempt can be made through a suprapubic incision to excise or destroy valves in the posterior urethra. Transurethral removal by punch fulguration or excision under vision by the surgical cutting current (Campbell) have all been employed. For hypertrophy of the verumontanum deep electroexcision of three or four full length longitudinal strips of tissue suffice. For contracture of the vesical neck one has the choice of the Young punch method, the caulk miniature cautery punch and the cutting loop technique as employed in adults but with proportionate diminution in caliber of the Stern McCarthy resectoscope. The technique of removal of obstructing congenital diverticula is the same as in adults. In Hyman's case the patient was only nine months when operated. In ureteroceles which block the vesical outlet (A of Fig 588) or prolapse through the urethra in female children (Fig 357) fulguration of the protrusion should first be tried before suprapubic resection is considered.

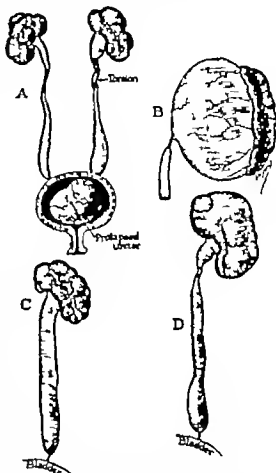


FIG. 588.—Various types of ureteral anomalies (personal observations). A Torson close to kidney with ureterocele which blocked vesical outlet and caused retention in a girl seven years of age. B Enormous extrarenal pyelectasis due to congenital stricture at the ureteropelvic junction in boy ten years of age. C Congenital stricture of lower end of ureter. D Congenital stricture at both ends of ureter in child.

UPPER URINARY TRACT OBSTRUCTION

THE ROLE OF ANOMALIES

We have decided to discuss these separately because the clinical pictures at least in the early period differ considerably from those incident to lower urinary tract obstruction by anomalies. The effects on the ureter and kidney are the same

in the early stages of obstruction by anomalies in the upper urinary tract as were described as a late development of obstruction by anomalies in the lower urinary tract. The sequence in the latter is urethra, bladder, ureter and renal pelvis and in the former, only ureter and renal pelvis. We have classified ureteral anomalies in Chapter 29 as 1 Anomalies of caliber and form, 2 Anomalies of origin and ending and 3 Anomalies of number. The various types under each heading are given in Chapter 29. We will only take up here the results of obstruction by anomalies which act in a mechanical manner, leaving the discussion of dilatation of the upper tract as the result of neurogenic dysfunction to be taken up in the following section.

CLINICAL PICTURES

These vary according to whether infection has supervened or not, the cases may be grouped as follows:

- 1 Those in which the outstanding clinical feature is the discovery on palpation of an enlarged kidney on one or both sides without concomitant symptoms.
- 2 Those in whom fixed or colicky pain in the upper abdomen of a child leads to a search for the cause in the ureter or kidney.
- 3 Those in whom a persistent pyuria accompanied by pallor, anorexia, loss of weight and strength, mild or more severe uremic symptoms which are not improved by medical treatment, dominate the clinical picture.
- 4 A single or recurrent attacks of the syndrome described under acute pyelonephritis without or with localizing signs in Chapter 39 are the outstanding clinical features in infants and children.

DIAGNOSIS AND TREATMENT

The diagnosis and treatment of anomalies of the ureter giving rise to mechanical obstruction has been taken up in Chapter 29. In addition to the ureteral anomalies discussed there, it is necessary to mention the possibility of obstruction of the renal pelvis being the result of anomalies of the blood supply of the kidney. The various forms of anomalous vessels to the kidney, their symptomatology, diagnosis and treatment are considered in Chapter 34.

NEUROMUSCULAR DYSFUNCTIONS OF THE URINARY TRACT

We will limit discussion here to those of the upper urinary tract. Neurogenic dysfunction of the bladder as it occurs in adults and children is taken up in Chapter 28. The occurrence in early life of nonobstructive dilatations of the upper urinary tract, a term employed by Hepler (*Jour Amer Med Asso*, 1937, 109, 1602), has not received the attention it merits on the part of both pediatricians and urologists.

Before taking up the question of etiology of this condition, we will briefly cite a case reported¹ by one of us which was followed for 18 months and illustrates most of the pathologic changes and clinical features. The symptoms were those of an acute renal infection in a baby girl eight months old. The temperature (daily) varied from 100-103 F for two months in spite of medical treatment.

¹ Eisendrath, Jampolis and Davis. Ureteral neuromuscular dystrophy in its relation to renal infection of children. *Amer Jour Dis Child*, 1929, 38, 1006.

Urological examination at this time revealed marked edema of both ureteral orifices but no obstruction to the passage on either side to 4 F catheters. The ureteral urine on both sides contained a very large number of pus cells and bacteria of the *B. coli* group. Bilateral urography (Fig 347) revealed a marked ureterectasis and pyelectasis with a sharp kink of the right ureter. Cystography failed to show any vesico-ureteral reflux. Marked improvement in the general and local condition followed elimination of the kink by an anastomosis. At this operation the ureteral wall appeared very thick and resistant. The acute renal infection symptoms recurred four months later but receded after use of an inlying ureteral catheter on both sides. A similar kink (Fig 347) was found at a second operation on the left side and eliminated by ureterolysis and nephrolysis. Up to the time of death from a bronchopneumonia 15 months after the first operation the baby's weight and general condition improved considerably but the ureteral urine and urography showed persistence of the chronic renal infection and ureteropyelectasis. At necropsy no obstruction was found in the lower urinary tract or ureter at any level. The ureteral orifices easily admitted a No 5 catheter. No kinks could be found on gross examination or injection of both ureters but the ureteropyelectasis still existed (Fig 347).

PATHOLOGIC AND CLINICAL PICTURE

This case illustrates the following pathologic and clinical picture so commonly found in these nonobstructive dilatations of the upper urinary tract:

- 1 No obstruction was found at urethrocystoscopy in the urethra or vesical outlet, and no trabeculation or residual urine.
- 2 No obstruction was encountered at the vesical end of the ureter on either side to both a 4 F catheter during life and a 5 F at necropsy.
- 3 The ureterectasis and pyelectasis were very marked on both sides and the urographic picture did not resemble at the vesical end that of a mechanical (stricture) obstruction.
- 4 The clinical symptoms were those of chronic renal infection with acute exacerbations.

ETIOLOGY

As to the etiology there is still some difference in opinion. Unilateral cases were reported by Bachrach (1914), Caulk (1923) and by Hurst and Gaymer Jones more recently (Brit. Jour. Urol. 1931 3: 43). These were all observed in adults. The last named authors believe the ureterectasis and pyelectasis are the direct result of inability to expel the urine through the intramural portion of the ureter because of an absence of relaxation of a supposed sphincter. They have applied the term achalasia or nonrelaxation of the sphincter which ought to relax so as to allow the ureteral urine to pass into the bladder. The weak point of this opinion is that no proof has ever been presented of the existence of such a sphincter in the lower end of the ureter.

In Children. Hepler (loc. cit.) has reviewed the question so far as it pertains to children. From the etiologic standpoint dilatations of the upper urinary tract in children may be divided into three groups: (a) those due to mechanical obstruction; (b) those that are a sequence of neurologic lesions, either central or peripheral involving the bladder; and (c) those in which no obvious cause

either mechanical or dynamic, can be demonstrated. In the last-named group the dilatation in some instances follows functional imbalance at the ureterovesical junction. The congenital megaloureter is characterized by a thickened, hypertrophic muscularis as in the above cited, whereas the enormously dilated thin-walled atrophic atonic ureter seen in later life represents the end stage of decompensation. Whether the dysfunction is the result of abnormal impulses through the hypogastric nerves or whether it is entirely intrinsic is not known. Hepler reported four personal cases and quotes Rizzì (*Arch ital di urol*, 1935, 12, 93) who has collected a number published in European journals which were associated with megalocolon or megaloesophagus.

The clinical picture is that of chronic renal infection with or without acute exacerbations as in the personal case observed by one of us. No line of treatment which will eliminate the cause has yet been found.

RENAL INFECTION IN CHILDREN

This differs in but few respects from the same condition in adults discussed in Chapters 39 and 40. There exist, however, certain distinguishing characteristics of renal infection in children which it is necessary to mention.

PREDISPOSING CAUSES

Obstruction due to persistence of anomalies, which in turn favors stasis, is the most important predisposing cause of both upper and lower tract infection in infants and children. Of lesser importance is the condition described above as giving rise to dilatation of the upper urinary tract without demonstrable obstruction. The following predisposing causes of infection of the urinary tract, as a whole, must be looked for in a child in the following order:

- (a) Pin-point opening in the prepuce
- (b) Urethral anomalies such as stenosis of meatus, stricture, diverticulum, hypertrophied verumontanum, valve formation in posterior urethra
- (c) Urethral calculi
- (d) Congenital contracture of vesical neck (Fig 586), congenital vesical diverticula (Fig 589), vesical calculi and foreign bodies, neurogenic dysfunction of bladder
- (e) Anomalies of the ureter (see Chapter 29), the most frequent are stricture at vesical end of the ureter, ectopic ureteral ending (Fig 353) and stricture at ureteropelvic junction (Fig 595)
- (f) Uretero- or nephrolithiasis (Chapter 42)
- (g) Neuromuscular dysfunction of ureter and renal pelvis (Fig 347)

CLINICAL PICTURES

The striking feature of urinary infections in children is the predominance of the clinical pictures, described in Chapter 39, in which there are few if any localizing signs pointing to the urinary tract as the seat of the trouble. This is especially true of children below the age of three years, a period in which the highest incidence of urinary infections with acute symptoms is observed.

The general symptoms such as high temperatures up to 106-7° F, restlessness, apathy, gastrointestinal disturbance, rapid pulse, etc., are so marked that

the kidney as the source has in the past frequently been overlooked. This does not occur very often at present, because the clinical picture of severe systemic symptoms as a rule leads the pediatrician to ask for exclusion of the urinary tract as the source.

Fever of obscure origin in children when there are no localizing signs must always be kept in mind as being often of renal origin. In older children when there is lower urinary tract obstruction the clinical picture is the one described at the beginning of this chapter. In others, with bladder calculi or more chronic forms of renal infection symptoms such as frequency, burning or pain on urina-

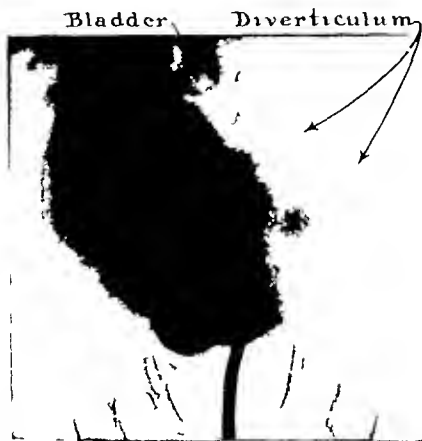


FIG. 589—Large diverticulum of bladder in boy of ten. (Courtesy of Dr. A. Hyman.)

tion and the presence of bacteria and pus in the urine. In some acute and chronic cases of renal infection the child complains of pain over an upper abdominal quadrant and the kidney is found to be tender on palpation and enlarged if an infected hydronephrosis or pyonephrosis has already developed. In the chronic cases the existence of a pyuria which resists medical treatment is the most frequent reason why the urologist is asked to examine the child. In these chronic cases there is a history in the majority of recurrent acute exacerbations which give rise to the clinical picture of fever etc. of obscure origin described above. This should always lead to the suspicion that some type of congenital obstruction favors the lighting up of the infection.

DIAGNOSIS

In the acute cases the diagnosis must be one of exclusion of other conditions such as pneumonia, typhoid, gastroenteritis, endocarditis, influenza and acute

miliary tuberculosis in which the systemic symptoms predominate over the local signs. If there is a history of similar attacks with pyuria in the free interval, the diagnosis is not as difficult as during a first attack. In some of these acute cases, the urine examination may be of great aid if there are a large number of pus cells to a low power field in the uncentrifuged specimen, but in others, especially if the acute attack is the first one, there may be so few pus cells that only cultures will aid in making the diagnosis. Very little should be done in these acute cases in the way of a urologic examination except to look for a distended bladder on suprapubic

FIG 590



FIG 591



FIG 590—Male, age 2 years, died, general toxemia, due to general urinary tract infection. History, frequent attacks abdominal pain and frequent and painful urination. Urine loaded with pus and colon bacilli. Filling capacity 5 c.c. right, 7 c.c. left. Note tortuous and dilated ureters, and large dilated pelvis. (Kindly loaned by Dr. Clayton K. Smith.)

FIG 591—Pyelograms from a case of unilateral upper urinary tract infection in a girl of six with recurrent attacks of fever and pyuria. Note dilated right pelvis and ureter ending suddenly at vesical orifice where a stricture was found.

palpation and inspect the prepuce and external meatus. If this search for an obstruction of congenital origin is negative, one is justified in the presence of acute or chronic retention to catheterize the child and decompress the bladder. In cases of acute infection due to obstruction or adynamic conditions in the upper urinary tract, cystoscopy and ureteral catheterization can do no harm and many relieve the acute symptoms by leaving a ureteral catheter in situ.

Urologic Examination. It is unnecessary to repeat here all of the steps of the urologic examination in chronic urinary infection (Figs 590 and 591). They do not differ in principle from those employed in adults (see Chapter 39). As to what is to be considered as pyuria is still a subject of discussion so far as cases are concerned in which only a few pus cells are found. This question is taken up in the chapter on the Interpretation of Pyuria.

The urologist who is asked to determine the source of a pyuria must always keep in mind that as in adults renal tuberculosis in children may masquerade under the clinical picture of a chronic renal infection. The same is true of urolithiasis and of all of the forms of mechanical and dynamic obstruction of congenital origin which have been enumerated above.

TREATMENT

This is similar to that employed in adults as described in preceding chapters. We will only repeat the various headings here.

In Acute Cases. Rest in bed, plenty of fluids (especially fruit juices in water), hypodermoclysis of 10 per cent glucose solutions if there is marked dehydration, colonic flushing, alkalization with potassium citrate solution or plenty of orange juice and use of the indwelling ureteral catheters (Fig 488). If it is impossible to introduce a catheter into the ureter a nephrostomy is indicated in severe cases. The use of mandelic acid has been reported by Newns and Wilson (Lancet 1936 II, 1087) in 24 acute and 10 chronic cases of renal infection in children. The dose was 15-30 grains (1-2 Gm.) four times per day according to the age of the child. Ten of the children had been unsuccessfully treated with potassium citrate. In all but three, the urine was rendered sterile often within a week. Of nine relapses, three were in children with anomalies of the urinary tract and two where the infection was due to an organism other than of the *B. coli* group.

In chronic infection, the treatment should include a large fluid intake, elimination of constipation and focal infections, efforts to render the urine sterile as outlined in Chapter 39, search for and correction of any cause of stasis in the lower or upper urinary tract and surgical measures as discussed in Chapters 39 and 53.

TUBERCULOSIS

UROGENITAL

A sufficiently large number of cases of renal tuberculosis in children have been reported to show that it is necessary to keep it in mind constantly (a) when ever a pyuria persists in spite of adequate treatment for a nontuberculous infection (b) If symptoms of cystitis associated or not with pyuria appear in a child and (c) during the search for the cause of an enuresis especially of the nocturnal type.

Incidence. As to the frequency of renal tuberculosis the most recent statistics are those reported by Mathé (Surg Gynec and Obst 1936 63 283) who found reports, including six personal observations, of 565 cases between the age of one to twenty years or 12 per cent of 4698 cases of unilateral renal tuberculosis reported between 1885 and 1935. Of the 565 cases 494 were between the ages of eleven and twenty years. If only the statistics are taken into consideration in

which the upper age limit is given as fifteen years, which is generally regarded as the dividing line between childhood and adolescence, we believe a more accurate picture will result as to the frequency of renal tuberculosis in infancy and childhood. The reports of Ekehorn and of Ivarson yield such information. The former in 1577 cases of renal tuberculosis found one between the ages of 1-5 years, 11 from 5-10 years and 52 from 11-15 years and the latter in 192 cases found 1 between the ages of 6-10 years and 7 between 10-15 years, thus making a total of 1769 cases in whom a renal tuberculosis was found between the ages of 1 to 15 years in only 72 or 0.41 per cent. If one only considers children below ten years of age, there are reports of 37 cases in a total of 3512, or slightly over 1 per cent.

As in the case of renal tuberculosis in adults, the urologist is only interested in the chronic type. All that has been said in Chapter 39 regarding the various forms, the pathologic changes in each of these, routes of infection, symptoms, diagnosis and treatment of chronic renal tuberculosis in adults holds true, with but slight modifications, for the same disease in children. Many of the cases seen later in life have begun in childhood, particularly in adolescents and young adults.

Clinical Pictures The most common clinical pictures observed in children may be grouped as follows:

1 SYMPTOMS LIKE THOSE OF A CYSTITIS, in the form of frequency, pain on urination and a pyuria

2 A PYURIA WITHOUT ACCOMPANYING SYMPTOMS, except slight evening rise of emaciation, fatigue, loss of weight, etc., which are not at all characteristic

3 INCONTINENCE, ESPECIALLY AT NIGHT

In general, any child presenting the symptoms of chronic urinary infection which does not improve following appropriate treatment, should be suspected of having a renal tuberculosis, until otherwise proved. As pointed out in the section on bacteriological examination of the urine (Chapter 8), to rely upon the smear (staining) method alone will allow many a case to escape detection at an early enough stage to render cure by nephrectomy permanent. The variation, from day to day, in the elimination of bacilli from a renal focus in tuberculosis, is so common that only through frequent examinations of the urine by the smear, culture and guinea-pig methods will it be possible to differentiate a nontuberculous from a tuberculous infection of the kidney.

THE COINCIDENCE OF NEPHROLITHIASIS AND RENAL TUBERCULOSIS has already been pointed out in Chapter 41. This combination was found in one of our cases, in which the clinical picture was that of a symptomless pyuria until the plain film showed a relatively large renal calculus which at operation was found in the pelvis of a tuberculous pyonephrosis.

As to treatment, no distinction should be made between the indication to remove a tuberculous kidney when still unilateral provided that the other kidney is a good functioning one and free from tuberculous involvement. In the presence of an advanced pulmonary tuberculosis or specific spinal and joint lesions, nephrectomy is contra-indicated.

Schall (Deut. Med. Woch., 1931, 2, 1975) reported a case which demonstrates that renal tuberculosis in children, when not operated, goes on to complete destruction of the organ as in adults. A diagnosis of unilateral renal tuberculosis had been made when a child was three years old, but permission to operate could not be obtained from the parents. Irradiation was given over both kidneys and

nine months after the last treatment, no tubercle bacilli were found in the urine. Six years later the child presented the signs of a tuberculous spondylitis and urological examination revealed a large tuberculous pyonephrosis on the side on which the diagnosis of an early renal tuberculous lesion had been previously made.

URETER BLADDER AND URETHRA

This as explained in Chapter 41 is secondary to a renal focus except in the rare cases in adults in which a tuberculous salpingitis ruptures into the bladder or when the bladder or urethra is infected by direct extension from a genital focus in the male.

TUBERCULOSIS OF THE MALE GENITALIA

A primary involvement of the testis is very rare but cases have been reported by Suss and Eisenstaedt. Tuberculosis of the epididymis is not as rare in children as that of the testis. The modes of infection, pathologic changes and clinical features resemble those of adults, even to the extent that the epididymal involvement may be masked by a secondary hydrocele, so that this should always be kept in mind in operations for this latter condition in children as in adults (see Chapter 20). Tuberculosis of the prostate and seminal vesicles is almost invariably secondary to a primary focus in the epididymis. Whenever a tuberculosis of the latter is diagnosed the possible existence of a renal focus must always be excluded. Early epididymectomy is the treatment of choice in children.

UROLITHIASIS IN CHILDREN

Here as in the case of nontuberculous and tuberculous infections we will only direct attention to important differences between lithiasis as it is found in the urinary tract of children and the same condition in adults.

Incidence etc., of Lithiasis in Children. The reports of 203 cases collected by Thomas and Tonner (*Jour Urol*, 1922 8 171) showed that 40 were in children up to five years of age, 60 between five and ten and 58 between ten and fifteen years. The age was not given in 45 cases. There were 155 males to 45 females (about 3 to 1). In three, the age was not given.

The localization was in one kidney in 29, various kidney and ureter combinations in 10, both kidneys in 14 (6 per cent), one ureter in 15, both ureters in 1, bladder in 116 (57 per cent) and urethra in 25 (12 per cent). Campbell in 74 cases (43 necropsy, 31 clinical) found 36 in children one year of age or younger, 15 under two years, 8 under 5 years and the balance below the age of 15 years. Lett (*Brit. Jour Urol*, 1936 8 216) reports 51 cases in children of 2781 patients with urolithiasis admitted during a period of 30 years to the London Hospital. Both Lett and Joly state that there is a distinct decrease in the number of urinary calculi observed in children in England but that this is not the case in India and China. In the latter two countries, as well as in some Southeastern portions of Europe, poor nutrition still plays an important part in the relatively high incidence of urolithiasis in children as shown by a report from Bucharest (*Rev. Rom. Urol*, 1934 1 106) of 110 cases of bladder calculus in children. Of these

98 per cent were in boys from 15 months to 15 years. The age period which showed the highest incidence was up to the sixth year, nearly 62 per cent.

The mechanism of formation, composition, localization and sequels of urinary calculi in children does not differ from those features described in previous chapters. The same complications are also found as shown by the report of a case by Schonfeld (*Amer Jour Dis Child*, 1935, 50, 686) of perinephritic abscess in a baby fourteen months old with bilateral renal calculi. That the latter condition is not at all rare in children is evident after noting its high incidence (12 per cent) in the 203 cases reported by Thomas and Tanner, as well as recent

reports by Dietrich, Cifuentes, Stoccada and others.

The clinical pictures in children do not differ materially from those observed in adults. Guillemet and Gayet (*Presse Médicale* 1936, I, 451) reported two cases of ureteral calculi in young children which were diagnosed as acute appendicitis, hence they urge that a plain film be made before operation for that condition. That anomalies of the kidney favor development of calculi in children is shown by the case of congenital hypoplasia (Fig 396) with four large ureteral calculi in which there was a history of passage



FIG 592—Embryonal adenosarcoma (Wilms' tumor) of kidney in child

of calculi and when the patient was first seen by one of us, a urethral calculus, which blocked the external meatus, had to be delivered.

The treatment of urolithiasis in all reported cases has been along the same lines as in adults (see Chapter 42). Suprapubic cystostomy is to be preferred in cases of vesical calculi.

NEOPLASMS OF THE UROGENITAL TRACT

KIDNEY

Of tumors of the benign type, only adenoma, cystadenoma (Fig 550) and fibroma are important. In four cases cited by Kretschmer and Doerhing (*Surg Gyn and Obst*, 1929, 48, 629), a mass was to be felt.

Embryonal Adenosarcoma. The most common neoplasm of the malignant type in children is the embryonal adenosarcoma (Wilms' tumor) (Fig 592) which has been considered in Chapter 43. Campbell (*Jour Amer Med Ass'n*, 1937, 109, 1606) could only find two cases of carcinoma. As to papillary adenocarcinoma (hypernephroma) it is also comparatively rarely observed in children whereas it is the most common type of malignant neoplasm in adults.

Malignant Neoplasms The distinguishing characteristic of malignant renal neoplasms in children as compared to those found in adults is that the presence of a mass in the kidney region is the first clinical symptom in children whereas it is a late one in adults. The opposite is true of hematuria which is the first symptom in the majority of malignant renal neoplasms in adults and a late much less frequent symptom in children.

The firm consistency of the mass its fixation to the posterior wall of the abdomen and location in one of the upper abdominal quadrants unaccompanied in 85 per cent of the cases by hematuria should always lead to the suspicion of the presence of a malignant renal neoplasm in a child. Not infrequently doubt may arise as to whether the mass (Fig 593) is a neoplasm or of inflammatory (nontuberculous or tuberculous) origin because of a coincident high temperature as shown in the chart (Fig 558) of a case of embryonal adenosarcoma. Excretory or preferably retrograde urography will soon enable the diagnosis of a renal neoplasm to be made. The urographic deformities are described in Chapter 43 as well as the treatment of embryonal adenosarcoma in children.

BLADDER

These are very rare in children. Deming (Surg Gynec and Obst 1924 39 432) found reports of 64 cases to which he added two personal observations. Rathbun (idem

1937 65 914) found 10 additional reports and also added a personal observation making a total of 75 cases of which 38 were sarcoma 16 myxoma 4 myxosarcoma 5 fibroma 2 each rhabdomyoma benign polyp and hemangioma 1 each neurogenic sarcoma fibromyoma neurofibroma leiomyoma dermoid and papilloma.

The tumors were found twice as often in boys as in girls. The symptoms were as in adults hematuria pain and disturbances of urination.

PENIS AND URETHRA

Aside from urethral polyps which are frequently found in the urethra of boys and may cause obstruction very few growths are seen.

TESTIS

We have already given attention to the higher incidence of neoplasms in the undescended testis in Chapter 21. Campbell (loc cit.) states that 150 cases of tumor of the testicle in children have been reported. There are two types of malignant neoplasm the embryoma or teratoma as it is often termed and the seminoma. The former resemble the embryonal adenosarcoma (Wilms tumor) of the kidney in presenting on histologic study structures indicative of origin from the three layers of the embryo. The seminoma arises from the cells of the spermatogenic system.



FIG 593.—Appearance of abdomen in boy three years old with protrusion due to large mixed cell tumor of left kidney (Courtesy of Dr D C Straus)

The diagnosis in children does not differ from that of the same condition in adults discussed in Chapter 21

Treatment Intensive irradiation followed by orchidectomy and post-operative irradiation as now employed for embryonal adenosarcoma of the kidney offer far better prospects of cure than operation alone

PROSTATE

These are almost invariably of a sarcomatous type and attract attention clinically by the difficulty which the child has in urinating and the presence of a palpable suprapubic mass corresponding to the distended bladder. On rectal palpation, a soft mass is felt extending well beyond the ordinary limits of the prostate

ADRENAL

These were considered in Chapter 42

GONORRHEA IN CHILDREN²

Although gonorrhea in children resembles in most respects the same type of infection in adults, yet there are some points of difference which it is necessary to emphasize

Boys

This usually presents clinically as a urethritis, which may escape detection for a time and be treated as a balanitis, if the child has a long prepuce or there is a narrow opening in the prepuce. Gonorrheal infection in boys is not as rare as was thought in the past, but its incidence in boys is considerably less than in girls. Although the urethra is most commonly involved in boys, a proctitis or stomatitis may be the only localization of the gonococcus. In practically every case it will be found that infection in boys has followed sexual contact with an infected female or is the result of boys being used for homosexual practices by means of pederasty.

Symptoms A gonorrheal urethritis in boys may often present, as stated above, under the clinical picture of a balanitis if the prepuce is long and its orifice small. Pain on urination is a relatively more prominent symptom of acute specific urethritis in children than in adults. The pain is often so marked as to lead to retention of urine in order to avoid urination. Complications such as epididymitis, prostatitis, arthritis are not observed as often in boys as in adults but have been reported.

The diagnosis is based on finding the gram-negative diplococcus of Neisser (see Plate III) by the staining methods as described in Chapter 8 and, if necessary, in case the smears are negative, by the culture method. Not infrequently the source of the discharge is not apparent until a tight prepuce is retracted or incised. It is always necessary to exclude a nonspecific urethritis due to *Micrococcus catarrhalis* and some degenerated strains of staphylococci, both of which are also gram-negative.

² We are indebted to Dr. I. Harrison Tumpeer for the section on Gonorrhea in Children in this chapter.

The prognosis is usually favorable if the treatment is persisted in and begun promptly. Stricture formation has been reported but is rare.

Treatment. Lavage of the urethra should be carried out three times daily if possible using either one fourth per cent Protargol or 1:5000 potassium permanganate. These lavages should be followed by the injection of 5-10 cc of a 1:3000 acroflavin solution to be retained in the urethra for five minutes. Sulfanilamide given alone is usually effective. The daily dose is 50 mg per kilogram in weight i.e., three-eighths of a grain per pound for 2-3 days then half this dose every six hours for several days. The precautions to be given when sulfanilamide is prescribed are given under Treatment of Gonorrhea in girls.

GIRLS

Although the most common localization is in the vagina and cervix, the possibility of extension to the fallopian tubes, peritoneum, urethra and rectum must be constantly kept in mind. Only thirty per cent of the cases of vaginitis are due to the gonococcus and when the latter is not found a search should always be made for *Trichomonas vaginalis*.

Modes of Infection in Girls. In practically all cases the gonorrhea may be traced to contamination by infected bed-linen, diapers, towels, wash-cloths, thermometers, bed pans, bath tubs and toilet seats. Sharing a bed with an infected contact, faulty technic in institutions or children's wards and inadequate examination before admission to the latter are also responsible for the transmission of the disease.

The unusual susceptibility of girls to gonococcal infection is due to the lack of resistance of the thin layer of columnar epithellum of the young child's vagina as compared to the much thicker layer of squamous epithellum in adults. Another factor which favors localization in the vagina in young girls is the absence of an acid reaction of the vaginal secretions as found in adults.

Pathology

In ACUTE CASES the hymen, vulva, vagina, cervix and urethra are intensely red, often showing erosions, submucous hemorrhages and pseudo-membrane formation. Skentitis and Bartholinitis are rare in little girls because these glands are not developed before puberty. The vaginal wall itself is more frequently involved than generally taught. The acute changes are less marked when the discharge decreases, but recurrence with or without purulent discharge is common.

In THE CHRONIC STAGE the skin often manifests eczematoid changes of a dry or scaly nature while the introitus is usually lax, bluish red and occasionally scarred.

THE CERVIX. The important factor in gonorrheal infection in girls is the cervix. With the increasing use of the vaginoscope it is found involved in practically all cases. It is swollen, red, eroded, granular, often covered with a pseudo-membrane and in many cases there are small punctate hemorrhages. The latter may be the only sign of involvement in certain cases. In the chronic stages the cervix may be large, swollen, distorted and is usually friable. In this stage it remains large and pedunculated with deep irregular crypts in its surface. The cervix does not resume its normal size and appearance in a patient with a latent gonorrheal condition until puberty occurs.

In general, the course of the disease is essentially due to an infection of the cervix. This fact is most important from the standpoint of treatment.

Symptoms The most important finding is the presence of a profuse, greenish yellow, creamy vaginal discharge, which later changes to a more mucoid type. Even when there is no visible discharge, dry yellowish-green spots on the child's underwear suggest the diagnosis. There may be burning and pain on urination, itching of the parts, and occasionally malaise and slight fever, but usually the diagnosis can be made by the discharge.

Course Before the introduction of modern methods of therapy, the course was protracted over a period of months or years. The average duration of a well treated case is described under Treatment. Despite treatment, many cases are unnecessarily prolonged because the careless parent overlooks the mild manifestations of the chronic disease.

Complications Inguinal adenitis occurs occasionally. Rarer complications are salpingitis, peritonitis, cystitis, arthritis, endocarditis, ophthalmia, and sepsis. The organism is frequently found in rectal smears, but there is little evidence that true proctitis occurs.

Diagnosis This is based on the local acute or chronic inflammatory changes and finding the gonococcus in the discharge. The smear method is less accurate than that of cultures, especially if the newer mediums are employed. However, if the following technic described by Blackfan is employed, a larger proportion of positive smears can be obtained.

TECHNIC FOR SMEARS Wipe the external genitalia with gauze moistened with 1:3000 mercuric bichloride solution, and dry with sterile gauze. Instil 2-5 cc 1:10,000 mercuric bichloride solution into the vagina with a medicine dropper and wash this solution back and forth once or twice with the medicine dropper. Place 1-3 drops of the suspension obtained on a clean glass slide and allow it to dry in the air. After it is thoroughly dried, fix the smear by heating and stain it by Gram's method.

Prophylaxis No female child should be admitted to a group of others whether in a hospital ward or other institution until vaginal smears have indicated the absence of infection. Examination should be repeated on successive days and even then the child should be moved into a small group before joining the general group.

Routine periodic smears should be made on all groups of girls.

There should be individual beds and no sleeping contact even with the mother. Individual linens, utensils, and other accessories should be provided.

U-shaped toilet seats should be provided and toilet facilities carefully inspected.

Even with all these measures contamination will nevertheless certainly occur unless attendants and nurses—the human element—carefully carry out isolation if not aseptic technic.

Treatment

A better appreciation of physiologic principles has resulted in more hopeful treatment by the use of hormones. Recently, a more efficient local treatment with antiseptic substances was evolved. In a considerable percentage of cases chemotherapy by the use of sulfanilamide has been successfully employed. Hoffman and associates (Jour. Amer. Med. Ass'n, 1938, 110, 541) reported a series of

twenty-five patients who were given sulfanilamide. Seven were cured in an average of 17.3 days and nine in an average of 42.9 days. Only two of the remaining nine were cured by additional administration of the drug. They found that it is comparatively futile to give more than two standard course of treatment. The children tolerated sulfanilamide extremely well as compared to adults.

Te Linde (Jour Amer Med Ass'n 1938 110 1633) applied clinically the discovery of Lewis that if the estrogenic hormone is given to children with gonococcic vaginitis thickening of the columnar epithelium could be brought out so as to convert it into the more resistant squamous epithelium of adults. Te Linde (loc cit.) reported the cure of 175 patients with gonococcic vaginitis by amniotin. All except sixteen to whom the product was given hypodermically in oil were cured by the use of amniotin vaginal suppositories. This author believes that the essential lesion of gonococcic infection of the lower part of the genital tract in female children is vaginitis and not a cervicitis as we have emphasized above.

RECURRENCES AFTER ESTROGENIC THERAPY are sufficiently frequent to indicate that success consists of more than routine administration of suppository or injections. However the occurrence of these failures does not detract from the effectiveness of the therapy in general. In the first place—if increasing acidity is a factor in the vagina this does not occur in the cervix. Secondly—there is no change in the histology of the cervix to make it resistant as is the vagina. The cervical crypts are the site of the residual infection and to a large extent the source of auto-reinfection. Vigorous attention must be directed to the treatment of the cervix. Too much emphasis cannot be exerted by repetition of the word 'cervix' to direct the therapy in its direction. It is important to treat the cervix with local antiseptics topically particularly if local lesions exist and sometimes by the use of ointments intravaginally.

Local Antiseptic Treatment. Comparison of various drugs used in local treatment with mercurochrome, merthiolate, metaphen, lactic acid and strong protein silver has demonstrated that protargol 2 per cent in tragacanth jelly is the most effective from the standpoint of rapidity of cure, infrequency of recurrences and effectiveness in combination with other measures.

PREPARATION. To 2 drachms (7.68 Gm.) of tragacanth ribbon are added 8 ounces (236.8 cc.) of an aqueous solution of the antiseptic to be used and 4 grains (0.256 Gm.) of sodium benzoate. The mixture is allowed to swell and is then expressed through cloth.

The jelly is warmed to body temperature and placed in a 10 cc. syringe to the tip of which is attached the distal 4 inches (10 cm.) of a sterile no. 12 French soft rubber catheter. Enough of the jelly is expressed to fill the catheter and lubricate its tip. With the child in the dorsal lithotomy position and the vulva cleansed with soap and water the catheter is passed into the vagina until resistance is encountered. This usually happens at a distance of between 1 and 3 1/4 inches (from 2.5 to 9 cc.) depending on the age of the child. It is important that the catheter extend to the cervix in order that the vagina may be completely filled. The labia are then pressed together around the catheter and the jelly is injected. After each cubic centimeter of the jelly is injected the vaginal orifice should be inspected so that one may determine when the vagina has been filled. From 5 to 10 cc. is usually required to fill the vagina completely although variations in the vaginal capacity of from 3 to 22 cc. have been found. The injection is continued as the catheter is

being withdrawn, and a small amount of jelly is left between the labia minora. A snugly fitting sanitary pad should be applied before the child leaves the table.

The ideal time for administering the jelly is after the child is in bed for the night. In a few cases the mother may be instructed in the technic, but in most cases the probability of incomplete filling of the vagina more than offsets the advantage of recumbent position for several hours after the instillation. Some children co-operate in the clinic but not with the mother.

There is surprisingly little difficulty with the patients, either in the endoscopic examination or in the treatment. Occasionally a child has to be restrained, but only for the first few visits. Careful observation and questioning fail to reveal the development of any psychic trauma in the group.

Inasmuch as the vagina is usually found packed with jelly at the end of 24 hours, the treatments are given every 48 hours, and in a few instances where the introitus was small and little material escaped treatments are given every third day. The average number of treatments is four weekly. There is an apparent cure in 80 per cent of cases in 1.5 months of treatment with an average of 1.33 months, and 10 per cent recurrences. Patients were classified as apparently cured only after weekly smears and cultures are consistently negative for three months. The average time from the beginning of treatment necessary to produce an apparent cure is about two and a half months.

Uses of Estrogen and Local Antiseptics The greatest success was obtained when the hormone and local treatment were combined. It has the added advantage of requiring a much smaller dosage of estrogen. A very practical method of treatment based on these findings consists of the following:

A routine treatment in cases of gonorrheal vaginitis of 6000 rat units of theelin in oil is given in 23 days. Sixty per cent of recurrent cases do not clear by second course when the theelin treatments are given subcutaneously. Those who are not cured by the first course, as well as the recurrences, are given protargol jelly for one and a half months. The results are almost uniformly successful. Finally, theelin is given in suppositories averaging about 2000 I.U. All recurrences clear by further treatments with theelin by suppositories. It is the present consensus of opinion that treatment with estrogen should be limited to the smaller doses and the shortest duration of treatment compatible with consistently good results.

Since treatment with estrogen should be limited to the smallest dose and the shortest duration of treatment compatible with consistently good results, the use of theelin in oil or in suppositories, with adjuvant local treatment in cases where the infection recurs, or does not respond, offers the most satisfactory form of treatment in gonorrheal infection of the lower part of the genital tract.

Kobak and Frankenthal, Jr., employed (*Am Jour Obst and Gyn*, 1937, 34, 292) the silver picrate suppository in a boroglycerin gelatin base. It melts rapidly at body temperature, and appears to diffuse easily throughout the surface of the vagina into its crypts. It is easily applied by the mother. Results in 22 cases showed rapid and definite improvement as evidenced by quick disappearance of the discharge and permanent negative smears in five of the cases. Such results were obtained in one week of treatment.

Recurrences As emphasized above, an appreciation of the rôle of the cervix is the key to recurrences, strictly speaking. Apparent recurrences after the child

has been discharged following successful treatment are probably reinfections. A cured case frequently has the same opportunity for reinfection as for the original disease, when such a patient returns home to infected contacts. Here as in the case of tuberculosis and syphilis, the family is the unit of study and treatment. Rediscovery of a case of vaginitis compels a survey of the family and other contacts and treatment of other individuals in this group if necessary.

Recurrences of vaginal infections will be negligible in an adequately treated child if the patient's cervix, and the patient's family are deprived of their gonococci.

ENURESIS

By this is meant the unintentional and as a rule unconscious voiding of urine predominantly during sleep. Most children (about 80-85 per cent) have enuresis only at night (nocturnal) some (2-4 per cent) only during the day (diurnal) and the rest (8-12 per cent) during both the night and day (nocturnal and diurnal).

Etiology. In most cases the immediate causes of enuresis may be grouped according to Calvin² under two large headings:

1 **ORGANIC OR PHYSICAL DISTURBANCES** the more prominent among which are (a) diseases of the central nervous system such as idiocy, cerebral palsy, spina bifida and tumors; (b) internal glandular disturbances; (c) urinary changes as when the urine is too acid or is excreted in too large a quantity (habit of drinking too much water), or when the specific gravity relations are reversed becoming high during the day and low at night; (d) diseases of the bladder and kidney such as infections, calculi and nephritis; (e) local irritations in neighboring organs such as narrow meatus, phimosis, pinworms, fissures and vaginitis.

2 **BAD HABIT FORMATION** due either to lack of proper training or to an over-sensitive nervous system (neurotic or emotionally unstable child). Both can be found in 90-95 per cent of the cases.

The many defects etc., in group one are only infrequently (5-10 per cent of the cases) the causes of enuresis and even when present, their correction does not usually control the bed wetting because the habit has been too strongly established.

Spina bifida occulta has been considered by many as being the cause of enuresis. Lesné, one of the leading French pediatricians, believes that no relation exists between the two conditions and Bize (Bull. Soc. Ped. 1934 32 606) who observed twenty children with spina bifida occulta states that the presence of such a spinal defect is not necessarily followed by enuresis.

Campbell (Pediatric Urology 1937 2 373) emphasizes the necessity of a thorough urologic examination of every child more than four years of age. Pathologic conditions in the urinary tract were revealed in about 60 per cent of the therapeutically resistant cases. Congenital anomalies such as ectopic ureteral openings (see Chap. 29), valves of the posterior urethra (Figs. 582, 583 and 584) and contracture of the vesical neck (Fig. 586) must always be looked for in persistent enuresis especially if it is both nocturnal and diurnal.

² We are indebted to Dr. Joseph K. Calvin for permission to use some of the material in his article (Jour. Amer. Med. Ass'n, 1928 28, 820).

Training In nurslings, emptying of the bladder is still a reflex mechanism, but later this reflex action is replaced by a voluntary mechanism, the result of training, the discipline first acquired during the day gradually becomes effective during sleep

This training may be begun as early as the sixth or seventh month but never later than the twelfth month After the child is trained for the daytime, night training should be attempted as follows Restrict fluid after 5 p m, be certain that the child urinates before being put to bed, forestall the first wetting by awakening the child between 9 and 10 p m and keeping him on the toilet until he urinates and finally, place him on the toilet as soon as he awakens in the morning Dry nights should be the rule by the time the child is $2\frac{1}{2}$ to 3 years of age

The chief causes of failure to train the child properly according to Calvin (loc cit) and consequently the psychologic causes of bed-wetting are

- 1 Postponing the training beyond the natural age
- 2 Arousing fear concerning the ability to control the bladder
- 3 Arousing a spirit of antagonism by lack of patience and making the toilet a battle-ground for discipline
- 4 Emotional scenes on the part of the mother or nurse concerning the use of the toilet, such as great concern over accidents, weeping, petting or coaxing excessively
- 5 Excessive "babying" by over-affection
- 6 Masturbation is often associated with enuresis in the emotionally unstable (nervous) child
- 7 Statements in the presence of the child that he has "weak kidneys" or "weakness of the bladder"

Treatment Most cases can be cured in a few weeks, but the utmost co-operation of the parents or nurse is essential Calvin (loc cit) recommends the following procedure

- 1 ANY PHYSICAL DEFECTS, especially phimosis, congenital valves of the posterior urethra, stenosis of the vesical neck and ectopic ureteral openings must be sought for and eliminated if the enuresis persists in spite of training and therapeutic measures
- 2 PROPER NOURISHMENT Many of these children are poorly nourished, hence proper diet, hygiene and tonics must be given
- 3 THE FOLLOWING GENERAL RULES WILL AID, and will result in improvement in most cases

(a) Fluid (milk, water, soup) should be restricted after 5 p m The evening meal should be light and dry, i e, consisting of cereal, custard, junket, bread, jello or fruit Tea, coffee, pepper, salt and condiments should be avoided at all meals Especially should salt and sweets be avoided after 4 p m, as these increase thirst

(b) The child should empty the bladder before retiring and again at 10 or 11 p m, one should be certain that the child urinates freely at these times

(c) Generally speaking, taken as a group, most children who wet the bed have an oversensitive nervous system, are high strung and very active and are not emotionally as stable as those who do not wet the bed, in short, they are the so-called nervous children This sensitive nervous system probably tends to respond too quickly to impulses sent to it from the bladder, consequently, there should be an afternoon nap if possible, and no excitement or high tension after

5 p. m. such as exercise, reciting, competitive games, loud laughter, movies or exciting radio programs. The child should sit down and play quietly after 5 p. m. He should not become too fatigued before retiring and should retire early, elevating the foot of the bed 6 inches is advisable.

4. **PSYCHOTHERAPY** through proper instruction of the mother is necessary to eliminate the psychologic causes of bed wetting enumerated previously.

(a) Certainly in older children (from 5 to 6 years and up) fear and anxiety of committing the act, the suggestion acting on the child's mind that he has failed to control a nasty situation, is a prominent cause of the difficulty. This type of child must be taught that the habit is not desperately tragic and must be impressed with the fact that the trouble always gets well, and that it continues because he is worried and keeps thinking about it. The mother must kindly ignore the mishaps and praise the successes highly—a difficult attitude for these mothers to assume. The problem should never be discussed in the presence of the patient. In younger children especially (from 3 to 5 years) the mothers should avoid emotional scenes when mishaps occur. In general, centering the attention of the enuretic child on his problem and shortcomings should be avoided. One should also avoid stressing sex in the treatment if possible. Psychoanalysis is rarely indicated except in adolescent children.

(h) After fear, anxiety, and emotional scenes have been eliminated, confidence must be restored to the child that he can be cured, as usually the child and the mother have given up. One should build up the faith that success can be attained and encourage each child. This is accomplished largely by suggestion. Usually some outside source of stimulation and inspiration is necessary. The physician rather than the parent can best build up this faith in the child. The physician must impress the child with the fact that he can cure him, but to drive this thought home in the child's mind it is necessary to perform some striking yet harmless procedure, i. e., a hypodermic injection of sterile water at the weekly visits to the physician with the absolute assurance to the patient that this will result in a cure.

A visible record of successes is a very good method of helping to cultivate an atmosphere of optimism and confidence. One should have the mother mark the successful days on a calendar with gold stars and give high praise, thus emphasizing the successes with commendation and reward. Leave the other days blank and never mention or indicate these failures. These gold star calendars should be brought to the physician's office with the patient at weekly intervals.

5. **MEDICATION** Although many pediatricians have relegated the use of drugs to an insignificant place in the treatment of enuresis, others believe that they are a great help in certain cases.

BARBITURATES Calvin (loc. cit.) uses the barbiturates in nervous, high tensioned children. If the enuresis is purely nocturnal, the drug is given at bedtime (1 grain or 0.065 Gm. to a child of 4 or 5 years). If diurnal, it is given in divided doses three times a day. The phenobarbital must be continued for at least two weeks until the habit is thoroughly broken and then the dose gradually reduced and discontinued unless there is a recurrence.

Atropine or belladonna in large doses will greatly help in certain selected types of cases, i. e., those in which there is a frequent desire for urination during the day associated with bed wetting at night. Normal children when taking large

therapeutic doses of belladonna urinated much less frequently in twenty-four hours, but passed about the same total twenty-four hour quantity of urine as when not taking the drug, provided the fluid intake was constant. This is explained by the fact that belladonna (or atropine) relaxed the smooth muscles of the bladder and so increased its capacity to hold fluid.

Changing the reaction of the urine may be of value at times.

ENDOCRINE PREPARATIONS If the enuresis is due to thyroid or pituitary dysfunction, thyroid extract or retropituitrin must be given in small doses.

In cases of diabetes insipidus, the hypodermic administration of pituitary extract twice daily stopped the enuresis and reduced the output of urine from about 6 to 8 quarts to $1\frac{1}{2}$ to 2 quarts.

6 SURGICAL TREATMENT In most cases is not necessary. Passing of sounds and the injection of fluids into the bladder to dilate it may be dangerous from the standpoint of introducing infection and should never be done unless a definite surgical indication is present.

7 CHANGE OF ENVIRONMENT Finally, the easiest method of curing enuresis, but one seldom agreeable to the mother, is to change the whole environment by removing the child to another home (boarding or nursery school) or hospital (especially in the ward). These bed-wetters almost invariably control the habit soon after being placed there, but must remain in the new surroundings for at least three weeks to obtain a permanent cure. Here the motive is that they try to do as the other children do and stand well with their fellows (be approved of). The attendants, however, should take an indifferent attitude toward the bed-wetting.

PART EIGHT

PATHOLOGIC CHANGES IN OUTPUT AND
COMPOSITION OF THE URINE

CHAPTER

47 ANURIA HEMATURIA, PYURIA, CHYLURIA

PAGE

875

ORIENTATION

In many text-books on urology, pathologic variations in the output and composition of the urine are discussed before the student has become familiar with the various clinical conditions which give rise to them. Our experience in the teaching of urology has impressed us with the advantage of having the student first become familiar with the various anomalies, injuries, infections, calculus formations and tumors of the urogenital tract so as to be able to fully appreciate the significance of the various sources of an anuria, of a hematuria or of a pyuria through having seen them clinically.

There are many causes of anuria which will be enumerated in the following chapter. If the student has acquired knowledge of such conditions as congenital lack of development (hypoplasia) of the kidney, of congenital absence of one kidney, of ureteral or renal calculi causing acute blocking or reflex inhibition of the secretory activity of one kidney by sudden blocking of its fellow and of destruction of one or both kidneys by disease or tumors as outlined in preceding chapters, he will not find it difficult to keep in mind the different causes of anuria as shown in Figure 594. The student has already been impressed with the frequency of hematuria or of pyuria as signs of various urological conditions in preceding chapters, so that he is now better able to appreciate how the urologist must constantly keep in mind that there are many sources of both of these signs as shown respectively in Figures 598 and 599. Chyluria is a relatively rare condition but must be thought of whenever the urine presents a milky appearance.

CHAPTER 47

ANURIA HEMATURIA, PYURIA CHYLURIA

PATHOLOGIC CHANGES IN URINARY OUTPUT AND COMPOSITION	
ANURIA	PYURIA
HEMATURIA	SOURCES
SYSTEMIC CAUSES	CHYLURIA
DUE TO LESIONS OF ADJACENT STRUCTURES	PHOSPHATURIA
DUE TO LESIONS OF THE GENITO-URINARY TRACT	OXALURIA
	URATURIA

PATHOLOGIC CHANGES IN URINARY OUTPUT AND COMPOSITION

These play a very important part in daily urologic practice. The appearance of anuria, hematuria, pyuria, chyluria, pneumaturia, etc., in a patient immediately raises the question as to the source of such a change in the 24-hour output or in the composition of the urine. A simple enumeration of the various sources without a knowledge of the various urological conditions discussed in preceding chapters is meaningless; hence we have thought it preferable to place consideration of how to interpret changes in the output and composition of the urine after instead of before a description of the various anomalies and diseases of the urogenital tract in the male and of the urinary tract in the female.

Changes in the 24-hour Output of Urine. The daily (24-hour) output as it is commonly termed of urine varies with the amount of liquids ingested and the amount lost through extrarenal channels such as profuse perspiration, vomiting and diarrhea. The normal average 24-hour output for an adult is 1200-1500 cc. (40-50 ounces). The quantity is increased (polyuria) during absorption of large serous effusions, many nervous conditions, diabetes insipidus and mellitus, chronic interstitial nephritis. The 24-hour output in diabetes mellitus is usually 2000-5000 cc.

If there is great loss of fluid, the quantity is greatly diminished, often to 200-300 cc. (6-10 ounces). Such a reduction in output is termed oliguria and it is encountered in any condition which interferes with the renal circulation such as a decompensated heart, acute and chronic (parenchymatous) nephritis. It also occurs if there is an incomplete blocking of the renal pelvis or ureter, high temperatures, profuse perspiration, severe diarrhea and vomiting.

When the urinary output ceases completely or perhaps amounts to 30-40 cc. in 24 hours, the term anuria is employed. Even though the patient has not voided for many hours, the bladder is found empty on repeated catheterization. Such an anuria is either the result of cessation of secretory activity, termed the secretory type of anuria, or the result of pelvic outlet or ureteral occlusion, termed the obstructive type. The various causes of both of these types which must be taken into consideration when an anuria dominates the clinical picture are given in the following grouping and illustrated in a diagrammatic manner in Fig. 594.

period there is either a gradual appearance of symptoms of intolerance or the sudden onset of manifestations of severe uremic symptoms

2 A PERIOD OF PARTIAL INTOLERANCE Symptoms of mild uremic character appear from the onset of the anuria or supervene after a period of tolerance of variable duration, usually in the latter case 6-8 days after the onset The patient complains of headache, lack of appetite, is apathetic or is unable to retain food or is nauseated In many of these cases, a recurrent or persistent hiccup is a prominent symptom, or slight muscular twitchings Unless the anuria is relieved, these mild uremic symptoms quickly are succeeded by those of the third clinical picture

3 STAGE OF ACUTE UREMIA OR PERIOD OF COMPLETE INTOLERANCE The symptoms which characterize this final period may appear suddenly within a few hours after the onset, after a variable period of tolerance or finally succeed the symptoms of more chronic uremic type enumerated in the preceding clinical picture of partial intolerance The patient in this acute uremic stage becomes comatose, and continues so until death supervenes The outstanding feature in addition to the coma is the appearance of generalized tonic and clonic convulsion In a recent article by Cabot and Iber (Mayo Clinic Bulletin, 1933, 8, 354) it is stated that muscular twitchings or convulsions are not to be expected unless vascular disease or glomerulonephritis is present We have observed both of these manifestations of uremia in calculous anuria

Diagnosis

The three clinical pictures are so typical that the chief question in a given case is to ascertain the cause, whether secretory or obstructive

THE CLINICAL HISTORY will throw light on whether the anuria is of secretory (renal) origin by questions directed toward obtaining information as to the prior existence of any of the renal causes mentioned in our classification The history of the passage of calculi or of operations for nephro- or ureterolithiasis is of value in concentrating one's attention on obstructive anuria as the cause The same is true of anuria appearing in patients who have been treated for the malignant lesions mentioned above Before modern urologic diagnostic methods were known, much attention was given to the history of colics on a certain side, but this is of less value at present

Urography The first step following the taking of the clinical history, is to take a plain film, but this may lead to a sense of false security, if it is negative for calculus, as we have had occasion to observe in several cases, in which much valuable time was lost because radiography was negative Cabot and Iber (*loc cit*) in four of sixteen cases, found that the calculus did not cast a shadow Cahill (Jour Amer Med Asso, 1935, 104, 1306) had a similar experience in 9 of 22 In a personal case, the shadow seen in the plain film proved to be that of a calcified retroperitoneal node lying at the same level at which an obstruction had been encountered, before operation, during ureteral catheterization in a case of anuria due to calculus blocking the ureter of a congenital solitary kidney Dax (Jour Med Bordeaux, 1931, 108, 187) reports two similar cases where the diagnosis was made by ureteral catheterization This latter method is the only reliable one in calculous anuria

Treatment

The question of how much can be done to relieve an anuria of secretory origin is still under discussion If there is a history of ingestion of some substance like

bichloride of mercury with anuria as a result of a nephrosis decapsulation has been tried but with very few successful results Walther has recently reported a successful result following bilateral nephrostomy

IN THE OBSTRUCTIVE TYPE due to compression of the ureters by a neoplasm only nephrostomy (bilateral) or ureterostomy preferably the former, can be considered.

IN CALCULOUS ANURIA, an effort should always be made to introduce a ureteral catheter beyond the point of obstruction If this is successful (Fig 596) the patient is placed on forced fluids until in a more favorable condition for operation. If the blood urea content remains high and there is little improvement in the uremic symptoms within 48 hours after insertion of the catheter beyond the calculous obstruction it is necessary to operate at once This is also true of

FIG. 596

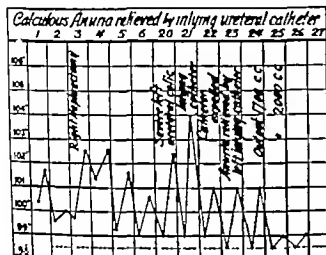
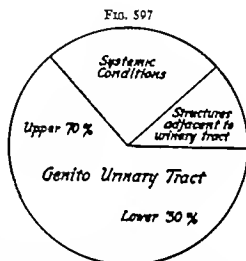


FIG. 596—Six days after nephrectomy (right) for infected nephrolithiasis, an anuria appeared due to impacted calculus in opposite ureter. Relief of anuria by use of indwelling catheter.

FIG. 597—Diagram of relative frequency of bleeding from upper (70%) and lower (30%) portions of the urinary tract, as compared to systemic and adjacent to urinary tract, sources.



cases in which the catheter is continually expelled after having been successfully introduced

If it is impossible to insert a ureteral catheter beyond the obstructing calculus no time must be lost in doing either a nephrostomy or a ureterostomy. The latter should be performed for an obstructing calculus in abdominal (iliac crest to kidney) portion of the ureter. If the patient is not in good condition it is better to be content with simple drainage rather than to make any attempt to remove the calculus.

FORCED FLUID TREATMENT should never be begun until after relief of the anuria in the obstructive type. The best solution for subcutaneous, intravenous and rectal administration is a 5 per cent solution of glucose.

Blood may be visible on gross inspection of the urine, i.e. it is macroscopic, or the blood is only found on examination of the urine microscopically. The solution of the problem as to the source of the bleeding in some cases is a very simple one. In others it may require a careful examination of the body in general combined with every diagnostic resource at our disposal for the localization of lesions in the genito-urinary tract.

Source A very convenient clinical division of the various sources of hematuria is

- 1 **Systemic causes** (Fig 597)
- 2 **Lesions of the viscera immediately adjacent to the urinary tract**, e g, the appendix, colon and the female genitalia (Fig 597)
- 3 **Lesions of the genito-urinary tract proper** Of these three groups of causes, the last named (genito-urinary lesions) constitutes about two-thirds of all The sources of the bleeding in this group are about equally divided between the upper and lower portions of the genito-urinary tract (Fig 598)

The order in which a search for sources of hematuria is usually made is as follows

- (a) Search for a source, in a well-taken clinical history, combined with a thorough examination of the body in general
- (b) A complete study by a urologist, of the genito-urinary tract, eliminating in succession every possible lesion in the third, or genito-urinary group, enumerated above

SYSTEMIC CAUSES

1 **Hemophilia** A patient suffering from hemophilia may complain of hematuria and this be the only local manifestation of the underlying systemic change This occurred in twenty of Locke and Minot's¹ cases of hemophilia One must, however, not overlook the possibility of a true hematuria, e g, from a renal lesion and a concomitant hemophilia In taking the history of a case of hematuria, the occurrence of ecchymoses after slight injuries is very significant One should never fail to determine the coagulation time of the blood as soon as possible If beyond, i e, longer, than eight minutes, it may be termed delayed

2 **Erythemia** (true polycythemia) Hematuria is not an infrequent accompaniment of the enlarged spleen found in this condition

3 **Purpura Hemorrhagica** Hematuria may occur as an accompaniment of the skin ecchymoses or independent of these The bleeding may be from the kidney alone or one may be able to see large confluent or discrete submucous areas of hemorrhage, cystoscopically In the clinical history, one will often learn that slight trauma was followed by subcutaneous ecchymoses, which were out of all proportion to the injury

4 **Leukemia** Hematuria was observed¹ in fifteen per cent of 135 cases by Locke and Minot¹

5 **Scurvy** Hematuria has been occasionally observed in this condition in adults It is not at all rare in children, both in scurvy and acute leukemia²

6 **Hodgkin's Disease** In three cases in which the external manifestations of the disease were slight, there was a hematuria

7 **Hematuria After High Protein Diet and After Exertion** Newburgh and Squer³ found red blood cells in the urine after high protein diet Similar findings have been reported⁴ in children after exercise Schulte and Nolting⁵ found

¹ J.A.M.A. 1924, 83, 1311 (Oct 25)

² Arch. Ped. 1923, 40, 607

Arch. Int. Med. 1921, 28, 1 (July)

⁴ Zeit. f. Kinderh., 1921, 20, 133

⁵ Jahrb. f. Kinderh. 1918

red blood cells in the urine of eighty four per cent of fifty young normal individuals and in ninety per cent of men over thirty five

HEMATURIA DUE TO LESIONS OF ADJACENT STRUCTURES

1 Appendiceal Hematuria We can no longer regard the hematuria (whether microscopic or macroscopic) which precedes accompanies or follows an attack of acute or recurrent appendicitis as of purely local origin. A certain small proportion of cases are due no doubt to the close proximity of the appendix to the ureter the infection being transmitted either by contiguity of

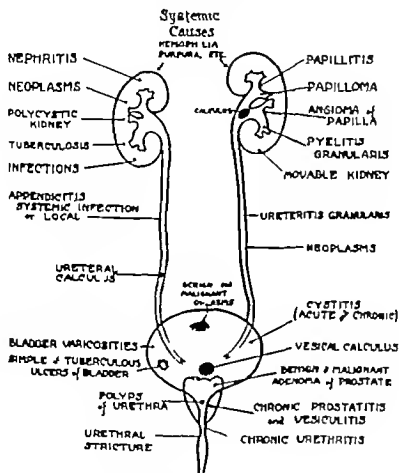


FIG 504.—Diagram of all sources of hematuria except those from structures adjacent to genito-urinary tract

the structures or by way of the lymphatics. In the majority of cases however there is ample clinical evidence to show that the hematuria is the result of an acute or subacute glomerulonephritis due to a hematogenous infection of one or both kidneys. Since we know that a unilateral nephritis is not rare the knowledge of such a unilateral or bilateral infection serves to clear up many hitherto puzzling clinical observations. We refer to cases (a) in which the hematuria precedes the acute appendicitis symptoms, (b) in which it is observed first on the right side and after the subsidence of the attack of appendicitis or perhaps from one to two weeks after an appendectomy recurs and is found to come from the left kidney, or (c) the blood is noted as bilateral during or shortly after the acute attack. It must not be forgotten that an appendicitis and a lesion in the urinary tract may coexist.

In cases presenting symptoms of subacute or chronic appendicitis, the most important ureteral condition to be excluded is stricture, which may present the same clinical symptoms as a chronic recurrent appendicitis and the same microscopic and occasionally even macroscopic hematuria, as in an appendiceal lesion (see Chapter 30)

2 Menstrual Hematuria This is a form of vicarious menstruation of which little is known by the profession in general. In a series of 201 cases of vicarious menstruation collected by Roth, it was vesical in nine and renal in two

LESIONS OF GENITO-URINARY TRACT

The detection of the source of bleeding may be very easy, if the lesion is in the lower portion of the urinary tract, because of its accessibility to urethroscopic and cystoscopic inspection. On the other hand, a prolonged search, with exclusion of one cause after the other, may be needed in the majority of cases of hematuria due to foci in the upper urinary tract. Every diagnostic resource must be employed in a more or less routine manner by the urologist, and not until all the data have been gathered and compared, should a conclusion be reached. We have found that if one visualizes in a diagrammatic manner (Fig. 698) the various lesions in the genito-urinary tract which can give rise to hematuria, the problem of exclusion is greatly simplified. A few of the more salient features of some of these lesions will be repeated here.⁶

A RENAL SOURCES OF HEMATURIA

1 Polycystic Kidney This condition may present itself clinically under the picture of persistent hematuria, often only of microscopic character, or as a massive hematuria, in both instances, from either one or from both kidneys. The essential diagnostic features are the evidence of nitrogen retention in the blood, diminution in function, the peculiar "dragon-like" deformity in one or both pyelograms (Figs. 471 and 472), and occasionally, the ability to palpate nodules on the surface of one or both kidneys.

2 Tuberculosis (Renal) In a small proportion of cases, the first symptom of this disease is hematuria, following the breaking down of minute foci close to the renal pelvis (Fig. 518). There is another form in which a symptomless hematuria is the principal feature. In this second variety, there is a nephritis⁷ on a tuberculous basis revealing but little change on naked eye inspection of the removed kidney.

3 Movable Kidney The acute congestion following the dropping of the kidney with kinking of its ureter, is at times followed by hematuria of such severity, as to resemble the hematuria so often seen in cases of renal neoplasms.

4 Infections of the Parenchyma, Renal Pelvis and Ureter That any one or all of the ordinary pyogenic infections of the parenchyma, renal pelvis and ureters, can give rise to hematuria, is now generally accepted. In the case of infections of the parenchyma, the underlying cause is a nephritis on an infective basis, with resultant injury to the glomerular circulation. In the cases in which the infection of the renal pelvis or ureter predominates, the most common pathologic change is the appearance of multiple minute nodules of an inflammatory character, a condition now referred to as granular pyelitis or ureteritis. We

⁶ See the respective chapters for a more detailed consideration.

⁷ See Chapter 41.

often see the same changes as the cause of persistent bleeding from the vesical mucosa.

5. Neoplasms of Parenchyma, Kidney Pelvis or Ureter The only reason for mentioning neoplasms of the parenchyma kidney pelvis and ureter again is that the progress which has been made during the last five years in urography enables the urologist to make a diagnosis of the presence of a neoplasm, from the deformity shown in the pyelogram or ureterogram at a period when it is often impossible to palpate any change in the size or contour of the kidney. Familiarity* with the normal conditions is essential here, as elsewhere in the interpretation of roentgenographic changes.

6. Lesions of the Renal Papillae Comparatively insignificant lesions such as small angiomas or fibrous changes in the papillae have been found to be the sources of hematuria in a fairly large number of cases.

7. Renal Calculi. In a certain percentage of so-called silent cases the only indication of the presence of a calculus is a persistent or recurrent hematuria of variable severity. The same is true to a lesser extent of ureteral calculi.[†] Although vesical calculi may be the cause of hematuria in children as a rule pyuria predominates in the clinical picture.

8. Hydronephrosis Hydronephrosis is not usually thought of as a source of hematuria. The bleeding may be quite severe and the initial symptom as in a recent case in our service at Michael Reese Hospital in which a sudden onset with hematuria as the predominant feature was followed by a rapidly enlarging hydronephrosis due to a ureteral kink at the outlet of the renal pelvis.

9. Embolism and Thrombosis of the Main Renal Vessels A hematuria may be the symptom of a blocking of the renal artery or vein in nonsuppurative thrombosis and embolism. In a recent study of 29 reported cases and a personal observation one of us (Jour Urol 1934 37 47) found eight cases of gross and one of microscopic hematuria. A gross hematuria of three weeks' duration was the chief complaint of the patient in a personally observed case. The urographic deformity (Fig 452) resembled that of a neoplasm because of the presence of masses of fibrinous exudate in the renal pelvis. The specimen of the kidney is shown in Plate X.

10. Nephritis Hemorrhagica (Nephrite Hematurique) Although the pathologic changes are bilateral as a rule one of the following clinical pictures may be present: unilateral hematuria throughout the period of observation; hematuria at first from one kidney later from the other or bleeding from the two kidneys at the same time.

There are few if any findings pointing to the kidney as the source of the blood i.e. an absence of edema, a rise in blood pressure, heart changes and rarely any casts or albumin between the attacks. The general condition is good and there is no change in the renal function or blood chemical findings. In some cases evidence of nephritis may develop later but at the period when one would well come such evidence it is absent. Ureteropyelography also fails to reveal anything abnormal. These are the cases to which attention has already been directed as to caution in the interpretation of the normal pyelograms. In approximately a fourth of the cases of hemorrhagic nephritis the hematuria is either accom-

* See Chapter 7

† See Chapter 31

panied by pain or is preceded or followed by it. The pain may be colicky and may resemble, in its severity, accompanying reflex nausea and vomiting, as well as in its radiation, the syndrome so familiar in calculous obstruction of the ureter. The pains may occur without hematuria, as an independent condition, known as *nephritis dolorosa*.

Instead of being colicky, the pain may be dull and aching in character, localized over one kidney and accompanied by the more or less constant presence of red blood cells in the urine. From time to time, the pain again becomes more colicky, and the hematuria increases correspondingly, in severity.

It is this last group of cases, to which the term "essential hematuria" was formerly applied. This has fortunately been discarded in favor of terms such as "hemorrhage from minute foci."

B URETERAL SOURCES OF HEMATURIA

1 **Neoplasms** These rank first, but as was stated in Chapter 31, they are uncommon as compared to renal neoplasms. The papillomata are usually implantation metastases following a primary growth in the renal pelvis. The carcinomata can arise primarily in the ureter and present hematuria as their first symptom.

2 **Ureteral Strictures** Although Hunner maintains that both a macroscopic as well as microscopic hematuria, is frequent, such has not been our experience.

3 **Ureteral Calculus** Microscopic hematuria is a frequent accompaniment of this condition, but a gross (naked eye) hematuria, occurs far less frequently, than in the case of renal calculi.

4 **Ureteritis** Independent of strictures, hematuria is frequently observed in cases of ureteritis granularis or cystica, less often in other types of chronic inflammatory change.

C VESICAL SOURCES OF HEMATURIA

1 **Neoplasms** These are the first to be considered, as the source of vesical bleeding, as was pointed out in Chapter 27. Of all of the types of neoplasms which give rise to the persistent hematuria, both microscopic and gross, the benign papilloma is the most frequent, next the papillary carcinoma and last of the three, the infiltrating variety of carcinoma as well as sarcoma. Benign neoplasms also give rise to hematuria, but it is minimal as compared to the above.

2 **Adenoma and Carcinoma of the Prostate** A severe hematuria, even to the extent of causing the bladder to be overdistended with blood, may be the first symptom of these two types of enlargements of the prostate. With the exception of such an occasional severe initial bleeding, hematuria is not an outstanding feature of prostatic enlargement.

3 **Calculus** This is a frequent source of hematuria, of moderate degree. The bleeding is often the result of the trauma inflicted upon the mucosa by the movements imparted to the calculus, by the contractions of the bladder wall.

4 **Simple and Tuberculous Ulcers** These are a common source of microscopic bleeding.

5 **Acute and Chronic Cystitis** Hematuria can be a prominent symptom of certain types of acute cystitis, like the acute hemorrhagic. It is infrequent in the chronic forms, except in cystitis granularis or cystica.

D URETHRAL AND (MALE) GENITAL SOURCES

These have been so fully taken up in the earlier chapters that we will simply call attention to the fact that with the exception of hematuria due to neoplasms, such as benign papillomata and carcinomata hematuria from urethrogenital sources is rarely macroscopic in character. We will only mention sources other than neoplasms e.g. stricture of the urethra chronic anterior or posterior urethritis without stricture and chronic prostatovesiculitis (bloody ejaculations)

PYURIA

Number of Leukocytes in Urine There is a lack of unanimity of opinion as to how many leukocytes can be considered to be normal. A recent article by Hepler (*Jour Amer Med. Asso.* 1935 105 499) on the significance of pyuria in children brings this question of when a specimen of urine can be said to show on microscopic examination the normal number of leukocytes to the foreground. Hepler applies the term pus cells to the leukocytes found in the normal urine a use of the term which we believe to be misleading. He states that the general standard of a normal limit seems to be from 6-8 pus cells per high dry field.

Todd and Sanford in the latest (1937) edition of their book on laboratory methods state that a very few leukocytes are present in normal urine. Students should be instructed to report a very few pus corpuscles when they find an average of three or more to the field of the 6 mm objective with 5X eyepiece. Under the microscope pus cells are granular containing one irregular or several smaller nuclei which are brought clearly into view by running a little dilute acetic acid under the cover glass.

Helmholz (*Jour Lancet*, 1930 50 131) gives as a normal in the uncentrifuged specimen obtained with ordinary precaution with boys two or three pus cells per low power field and in the urine of girls not more than six or eight cells. Campbell (*Pediatric Urology* 1937) considers 3-5 pus cells per low power field in an uncentrifuged catheterized specimen as within normal limits.

The necessity of examining catheterized specimens at least in children was shown by Hepler (*loc. cit.*) Of 687 children with pus in the voided urine only 99 had it in the catheterized specimen but it must be remembered that of these 99 the number of pus cells as Hepler calls the leukocytes (independently of any concomitant bacteriologic findings) was less than 1 per high dry field in 34 and 1 to 5 per high dry field in 39 centrifuged specimens obtained by catheterization in children. The remainder (26) of the urines obtained and examined under the same conditions, showed from 5 to 20 per high dry field.

If one accepts as a standard that an average of five to seven leukocytes per high dry field in a catheterized centrifuged specimen can be considered as normal it would not seem fair to designate the 73 specimens containing a lesser number as examples of pyuria.

After reviewing the literature of the last ten years we do not see any reason to change the opinion expressed in the 1934 edition of this book that a leukocyte content of 5-7 to the high power field in a centrifuged catheterized specimen is still within normal limits.

A method which is very accurate in determining a normal standard of leukocytes in the urine and of following a case of pyuria clinically is that of observing

the number of corpuscles per cubic millimeter upon the blood counting slide, but the intake of water must be kept as uniform as possible. In cystitis, the number varies from 5000 for each cubic millimeter in mild cases to 100,000-150,000 in severe cases.

SOURCES

In the enumeration of the sources, we will take them up in the order in which a search for such an underlying lesion would be undertaken.

1 Urethral and Paraurethral Sources These include search for evidences of persistence of infection, originally due to the gonococcus, but superseded by the ordinary pus producing organisms or there may have been a primary nonspecific

infection. A glance at Figure 599 will refresh one's memory as to possible sources in the shape of soft or hard (true strictures) infiltrations of the anterior or posterior urethra, infections of the urethral glands (Littre) and lacunae, Cowperitis, prostatitis and seminal vesiculitis, periurethral abscess, etc. It is beyond the scope of this chapter to describe how such a topical diagnosis is made, but it may be said in passing, that one of the most common sources of the persistence of pyuria, especially of minor degree, is a chronic prostatitis, a vesiculitis or an overlooked infiltration of the wall of the bulbous or membranous portion of the urethra. Many of these cases are latent, so far as symptoms referable to the genito-urinary tract, are concerned. It is only during a thorough search for the focal infection underlying recurrent attacks of arthritis, myalgia, neuritis, etc., that such a source of pyuria is detected.

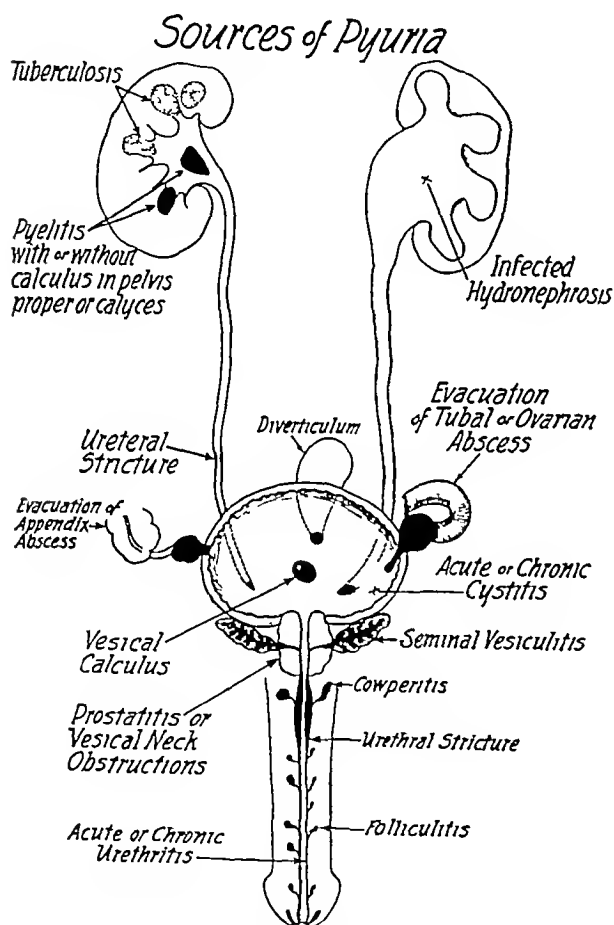


FIG. 599.—Diagram of various sources of pyuria.

2 Vesical Sources A primary cystitis is infrequent. One must never consider a search ended, even after the seat of a pyuria has been localized in the bladder, without taking into consideration a possible stricture of the urethra. Some form of obstruction at the vesical neck, the presence of calculi or of a neoplasm or of diverticula and finally of upper urinary tract infection, may be responsible for the pyuria.

OBSTRUCTION AT THE BLADDER OUTLET We have learned that these can be found as responsible for a pyuria, at all ages. Beer, C. G. Mixter, Hyman and others have recently emphasized the necessity of looking for both valvular and

similar obstructions in the urethra, and for contracture of the vesical neck in infants and children. In the latter as well as in adults the urologist is constantly looking for openings of diverticula (Plate VIII) of congenital origin, as potential sources of pyuria. In adults, prostatic hypertrophy is no longer regarded as the only anatomic form of vesical outlet obstruction. Median (fibrous and glandular) bar formation, as pointed out by Alexander Randall and fibrous contracture of the orifice and prostatic urethra, have been assigned places of equal importance with that of prostatic hypertrophy. The retention of urine which results from either such a mechanical obstacle at the vesical neck or of an atony of the detrusor muscle, favors localization of the organisms constantly present even in normal urine.

PSYCHIC RETENTION. One must never omit an examination of the nervous system as a cause of retention of urine not due to mechanical causes. These so-called "cord bladders" are often however not due to disease of the spinal cord. One can not refrain from making a plea for thorough search for the above causes of urinary retention, before an attempt is made to treat a pyuria of vesical origin or to remove calculi located there.

OTHER COMMON SOURCES OF PRIMARY VESICAL PYURIA are granulomas granular and similar types of chronic cystitis, neoplasms (both benign and malignant) multiple shallow diverticula and communication with perivesical foci of infection (rupture of appendiceal tuboovarian (Fig 600) and similar abscesses into the bladder).

Cystoscopy alone or urethro-cystoscopy aided by plain radiography and cystography will enable one to localize a pyuria as being of vesical origin far more rapidly and accurately than any other method.



FIG. 600.—Two test tubes with urine from case of communication of a tuboovarian abscess with bladder. The tube on the left is from a freshly catheterized specimen and is only slightly turbid. The tube on the right shows very marked pyuria after suprapubic pressure with catheter still in bladder.

3 Renal and Ureteral Sources These are grouped together, because it is not always an easy task to distinguish, whether an infection is predominantly renal or ureteral. In a fairly large proportion of cases, one can localize the source of the pyuria as being in the upper urinary tract by the appearance of the ureteral orifice or by observation of a thin or thick purulent¹⁰ efflux from the corresponding side. We cannot depend upon these findings alone, but must use bulbous or similar bougies in order to determine the presence of ureteral stricture, also plain radiography supplemented by ureteropyelography.

The search for the source of an upper urinary tract pyuria has been so ably developed by urologists, that it is the duty of every practitioner to have cases of pyuria examined at the earliest possible moment.

THE MOST COMMON RENAL AND URETERAL SOURCES OF PYURIA are the following

- (a) Strictures of the ureter of pre- or post-natal origin
- (b) Calculi or neoplasms
- (c) Nontuberculous infections
- (d) Tuberculosis

(a) Although one may not agree with Hunner that ureteral strictures occur as frequently as he believes, yet a search for their presence should be made, not only in adults, but in children, as well. There are many cases of persistent pyuria in infancy, which are due to overlooked anomalies of the ureter.

(b) In regard to renal and ureteral calculi, we are accustomed to think that they always give rise to symptoms indicative of their presence. Nothing could be more erroneous, so that whenever an infection, due to ordinary pyogenic organisms, of the upper urinary tract—does not respond to treatment, one should suspect that a ureteral or renal calculus is present. To demonstrate this, is not always a simple task, when one recalls the fact that about fifteen per cent of such calculi do not yield a shadow on the radiographic film.

In regard to pyuria due to nontuberculous infections, the localization and estimation of the degree of damage which has been done, is not very difficult when our present-day urologic methods, such as ureteral catheterizations, ureteropyelography, blood chemistry, functional tests, etc., are applied.

One of the most difficult problems is offered by renal tuberculosis as to localization and diagnosis. About sixty-five per cent of all cases present clinically (Fig 507) under the picture of a chronic cystitis, hence if a pyuria persists with symptoms incident to this affection, one should always suspect a possible renal tuberculosis. In about ten per cent of the cases of this disease a symptomless pyuria (Fig 507) is an outstanding feature.

CHYLURIA

This is the result of obstruction of the thoracic duct with insufficient development of collateral lymphatics so that there is a retrograde flow to the lymph nodes draining the kidney, ureter and bladder.

The urine is usually milky in appearance, but cases are reported in which there was so much blood that the diagnosis was made of hematochyluria. When the urine is only milky, microscopic examination reveals innumerable minute

¹⁰ Plate XII

droplets of fat, which disappear when ether is added and the specimen shaken the urine becoming clear

Parasitic Form. There are two principal forms of chyluria the parasitic and the nonparasitic. The parasitic form is most frequently the result of *Filaria bancrofti* infection which is very common in tropical and subtropical countries but has been found among the poorer classes of the southern states of this country. The *Filaria bancrofti* live in pairs in the lymphatic channels and often occur in such numbers as to obstruct the flow of lymph. This is in all probability the cause of the thoracic duct obstruction with backflow into the chyle into the lymphatics draining the urinary tract.

RENAL ORIGIN In the parasitic form the chyluria is usually of renal rather than of vesical origin although cases have been reported by Bloch Kidd and others in which the chyle was seen escaping from a protrusion in the bladder. No cases could be found of parasitic chyluria of ureteral origin.

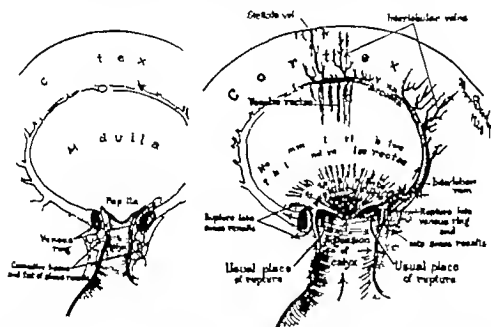


FIG. 601.—A schematic drawing illustrating the effects of distention of the calyx and the path ways followed by the injection mass in the production of pyelovenous backflow (Courtesy of Dr. H. F. Traut and of Surgery, Gynecology and Obstetrics.) From article by Dr. Herbert F. Traut in Surg., Gynec. and Obst., 1929 48 662

Inoue (Abstracts Zelt Urol Chir 1936 42 159) has made some interesting retrograde urographic observations in cases of chyluria of *Filaria bancrofti* origin. In 45 cases, he found extrapelvic escape of the opaque medium in 22 (46.8 per cent). In 7 of the 22 cases the lymph vessels draining the kidney (Fig 31) were distinctly visualized. Kitagawa and Ohmori (Jap Jour Urol 1935 24 329) found pyelolymphatic reflux of the opaque medium very frequently in 11 cases in which retrograde urography was used.

Mercier and Montaigne (Jour Urol 1935 40 75) were able following retrograde urography to visualize the direct communication between the renal pelvis and the lymphatics around the pedicle in a case of *Filaria bancrofti* chyluria.

Hayashi (Trans Japan path soc., 1924 14 190) reported the necropsy findings in a case of filarial hematochyluria which had been followed clinically for three months. A marked dilatation of the thoracic duct as well as of the

retroperitoneal lymphatics was found containing many microfilaria. A direct¹¹ communication was found between the extrarenal lymphatics and the calices in both kidneys.

Non-Parasitic Form There are comparatively few reported cases of non-parasitic chyluria. Lower and Belcher (*Surg Gynec and Obst*, 1924, 39: 147) could only find twelve previously reported cases. Since this publication cases

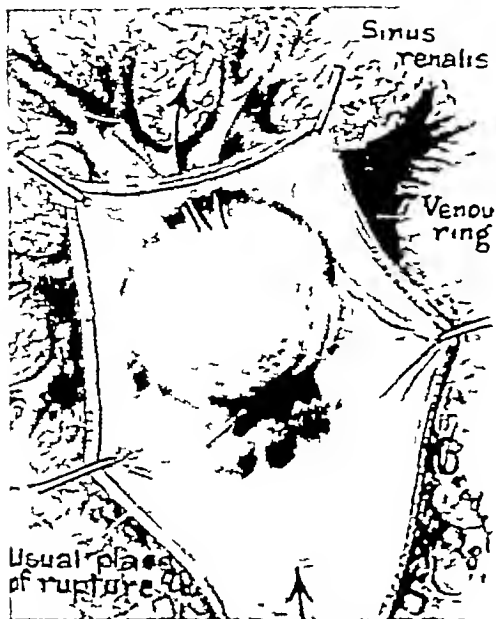


FIG. 602.—How pnelovenous reflux takes place (see also Fig. 60). A minor calyx opened to show multiple points of rupture at the margins of the papilla where the pelvis is reflected over the papilla. The relation of the point of rupture to the venous ring and the pathway of the injection mass is indicated. (Courtesy of Dr. H. F. Traut and of *Surgery, Gynecology and Obstetrics*.) From article by H. F. Traut in *Surg., Gynec. and Obst.* 1929, 48, 662.

have been reported by Welfeld, Kutzmann, Wood, L. Strauss, Bedrna, Alessandri, Ball and Yates-Bell and others. The lesions obstructing the thoracic duct were neoplasms, aneurisms, aneurism and abscess formation. In a case observed by L. Strauss (*Zeit. Urol. Chir.* 1933, 38, 347) the chyluria appeared for only two days before a nephrectomy for sarcoma in a four year old child. In Wood's case (*Jour. Urol.* 1929, 29, 101) the perirenal lymphatics could be visualized following retrograde urography. Wesson (*Urol. and Cut. Rev.*, 1933, 37, 692) reported a personal observation and one of Dr. Callender of infection of the perirenal lymphatics in patients who gave a history of non-parasitic chyluria. Similar visualization of the perirenal lymphatics following retrograde urography in which no force was employed during the injection, have been reported by Bonar, Exley, Ellis, Eisendrath, Abeshouse and others.

Symptoms of chyluria are the sudden appearance of milky urine or of a bloody milky (hematochyluria) urine. It may only be noticed after a meal rich in fats or drink-

ing a mixture of equal parts of milk and cream. The chyluria may be constant, appear once or twice or at irregular intervals. It may be only nocturnal or only diurnal. It can exist for years, without any systemic symptoms.

The diagnosis of whether one or both kidneys or the bladder alone is the source of the chyluria can only be made by cystoscopy and ureteral catheterization. Before employing the latter, the bladder should be systematically inspected for a bulging from which the chyle is escaping. This was found in the cases reported by Bloch and Kidd, but was sought for by others unsuccessfully when a renal source was excluded.

The treatment of the filarial, i.e., parasitic form of chyluria according to the reports of Japanese urologists which has been most successful in the renal type is lavage of the renal pelvis with a 20 per cent solution of sodium iodide. Kitagawa cured 14 of 18 cases with two instillations of this solution. The treat-

¹¹ This communication between the perirenal lymphatics and those of the kidney follows the same mechanism as in pnelovenous reflux (see Figs. 601 and 602), i.e. instead of the reflux taking place by way of the veins, it takes place by way of the lymphatics.

ment of the non parasitic form depends upon the cause of obstruction of the thoracic duct, such as aneurism retroperitoneal neoplasm or enlarged lymph nodes perinephritic abscess or neoplasm of the kidney. If no apparent cause can be found the use of neosarsphenamine has been recommended.

Bedna (*Zeit Urol Chir*, 1931, 32 443) reports a case in which the chyluria ceased after extraperitonization of the bladder and Bloch, after fulguration of a lymphatic varicosity in the bladder.

PHOSPHATURIA

The urinary phosphates are of two kinds (a) alkaline sodium and potassium phosphate and (b) earthy calcium and magnesium phosphate. The latter are frequently precipitated in neutral and alkaline urine as amorphous phosphates, whose presence as a sediment in the urine either means a diminished acidity or an increase in the proportion of phosphoric acid eliminated as phosphates. As a transitory clinical condition it is often observed after ingestion of food rich in alkalis or alkaline (earthy) phosphates. It also accompanies gastric conditions in which there is hyperacidity, disturbances of internal secretion and is also frequently observed in nervous individuals. Phosphaturia may be more or less persistent and form a distinct clinical entity. In one type the infected or bacterial there is a precipitation of crystals of ammonio magnesium phosphate (triple phosphate) as the result of the action of urea-splitting bacteria (see chapter 39).

Clinical Features. In the noninfected type the outstanding clinical feature is the milky turbidity of the freshly voided urine which becomes clear on the addition of a 10 per cent acetic acid solution. Microscopic examination of the sediment in freshly voided urine reveals the presence of amorphous phosphates and triple phosphate crystals predominantly the former.

In the treatment of temporary phosphaturia foods should be avoided especially fruits which make the urine alkaline. As to the more persistent noninfected type all predisposing causes such as disturbances of internal secretion hyperacidity and emotional strain. A diet which should include the foods forming the acid ash diet is to be recommended as keeping the urinary phosphates in solution. This diet can be supplemented by the administration of ammonium chloride 0.5 Gm (7.5 grains) t.i.d. or phosphoric acid (5 per cent solution) 20 drops t.i.d.

OXALURIA

Calcium oxalate is precipitated under the same conditions as the phosphates by a change in the reaction of the urine toward the alkaline side. The urine is not turbid, only a slight whitish sediment forming on standing. Oxaluria is observed in diabetes jaundice leukemia digestive disturbances and in nervous individuals also following the ingestion of foods rich in oxalic acid, such as spinach tomatoes asparagus and rhubarb.

Symptoms. Oxaluria does not as a rule cause any symptoms unless the crystals are passed in large quantities so-called showers when colicky pain like that seen in ureteral calculi or burning on urination is complained of.

The treatment includes the intake of a large amount of fluid to dilute the

urine, the use of foods which do not contain much oxalic acid and, if necessary, the administration of acidifiers

URATURIA

Uric acid is the most important of the purine bodies, which are derived chiefly from the nucleins of the food, exogenous uric acid, and from metabolic destruction of the nuclei of the body, endogenous uric acid. Excretion of purines is greatly increased by a diet rich in nucleins, as sweetbreads and liver. Uric acid is frequently deposited in the urine, in the form of crystals but is, as a rule, found as amorphous urates, chiefly sodium and potassium. These form a yellow or red "brick-dust" deposit which disappears on heating the urine. A deposit of amorphous urates is very common in concentrated and strongly acid urine, especially in cold weather, and has no significance. Beer has called attention to the fact that uric acid crystals when passed in large quantities, i.e., in so-called showers, may give rise to colicky pain like that observed in ureterolithiasis.

PART NINE

OPERATIVE TECHNIC

CHAPTER	PAGE
48 OPERATIONS ON THE PENIS AND URETHRA	895
49 OPERATIONS ON THE PROSTATE AND SEMINAL VESICLES	908
50 OPERATIONS ON THE SCROTUM AND ITS CONTENTS	928
51 OPERATIONS FOR STERILITY IN THE MALE	943
52 OPERATIONS ON THE BLADDER	948
53 OPERATIONS ON THE KIDNEY AND URETER	967
54 POSTOPERATIVE COMPLICATIONS IN UROLOGY	1022

ORIENTATION

In Part One we have discussed some of the nonoperative methods of treatment of urological cases. In the next six chapters the technic of the most frequently employed operative procedures will be described in as simple a manner as possible. In the final chapter, some of the more important complications which may occur after operations in general and those on the urogenital tract in particular will be reviewed, so that the student may have a working knowledge of how to prepare a urological patient and how to watch for complications following operation.

Of the various procedures on the penis and urethra, the student is especially recommended to study the technic of circumcision and of meatotomy.

Although perineal prostatectomy is the operation of choice for some urologists, the majority prefer either the suprapubic approach or the more recently introduced method of transurethral resection. The operations for radical cure of hydrocele and for undescended testis are preferred up to the present time by most urologists rather than the injection treatment for hydrocele or endocrine therapy for nondescent of the testis. The endocrine treatment as mentioned in an earlier chapter can be given a six months' trial but in case of failure, orchidopexy should not be postponed until such an age that there is little chance for the testis to develop when placed in the scrotum. Under technic of operations on the bladder we have included a description of the use of radon seeds in cancer and also the various endovesical manipulations for removal of foreign bodies. The operations on the ureter and kidney have been placed in one chapter, to save repetition of the description of incisions to expose these structures. Nephrectomy in simple cases differs considerably from that in which the fatty capsule is firmly adherent and greatly thickened. Temporary drainage of the kidney, i.e., nephrostomy is being more and more frequently employed. Although one cannot pass final judgment on the value of conservative operations for hydronephrosis, the various methods are described as briefly as possible.

Of all the postoperative complications, acute gastric dilatation and renal ileus deserve special attention on the part of the student.

CHAPTER 48

OPERATIONS ON THE PENIS AND URETHRA

DORSAL SLIT
CIRCUMCISION
MELOTOMY
URETHROTOMY

AMPUTATION OF THE PENIS
RADICAL OPERATION FOR CARCINOMA OF THE
PENIS
HYPOSPADIAS
EPISPADIAS

DORSAL SLIT

Indications. This is most frequently performed for the inflammatory phimosis (Fig 215) commonly associated with chancroids. Relief of the phimosis by incision permits direct medication of the chancroids which can be felt through the edematous prepuce but which cannot be seen because of the inability to retract the prepuce. Many cases of phimosis due to chancroids clear up with frequent bathing of the penis in warm water and irrigations of the lesions under the prepuce, thereby obviating a dorsal slit. A dorsal slit in the presence of chancroids very often means that a chancroidal ulceration of the dorsal incision will develop later. A dorsal slit is frequently indicated for paraphimosis, due to chancroids, and rarely, for that occurring in acute gonorrhea. It is not an uncommon experience to find that after retracting the prepuce in phimosis it is impossible to bring it forward again thus necessitating a dorsal slit. The constriction band is sometimes so marked in paraphimosis as to interfere with urination.

Operation. The prepuce is anesthetized in the median line dorsally in the line of incision—a one per cent novocaine solution is satisfactory. The mucosa and skin should both be infiltrated. A small circumcision forceps is now applied at the edge of the prepuce one on each side of the median line and a grooved director is inserted (Fig 603) under the prepuce down to the corona. A sharp pointed surgical scissors is now inserted along the grooved director and the prepuce divided not injuring the glans penis. After the incision is close to the coronal sulcus the grooved director is removed and the prepuce retracted to determine whether the incision is sufficient.

Incision of the mucosa, up to within one-eighth to one-fourth of an inch from the glans and also the severing of the subcutaneous bands and edematous tissue at the coronal junction are necessary for the dorsal slit to be successful.

When a dorsal slit is performed in an early case of paraphimosis it is well after proper anesthesia to incise the skin of the prepuce at the junction with the mucosa, enough to relieve the tension then draw the prepuce forward (Fig 233) and continue the operation as for dorsal slit in phimosis. This is often impossible so that incision of the exposed mucosa and skin will suffice.

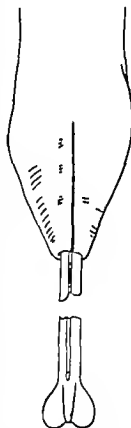


FIG. 603.—First step of dorsal slit. A grooved director is introduced beneath the prepuce and the latter divided with a scissors, using the groove of the director as a guide.

There is often considerable hemorrhage following the slit, but this usually subsides after a short period, during which the organ should be bathed in warm water. A loose bandage applied later, will usually take care of the bleeding. Many prefer not to suture the skin and mucosa in order to permit rapid relief of the edema and no attempt is then made to ligate the small bleeding vessels. It is however, best to place a suture at the upper angle (Fig 604) of the incision, the apex of the V, and one or more on each side uniting the mucosa and skin. In this way, the hemorrhage is easily controlled.

Dorsal slit is usually preliminary to a later circumcision, which should never be done in the presence of infection. Some operators make lateral slits also. Others perform dor-

FIG 604

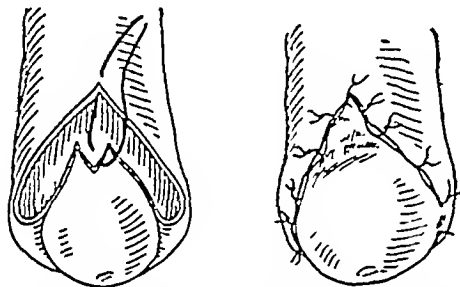


FIG 605

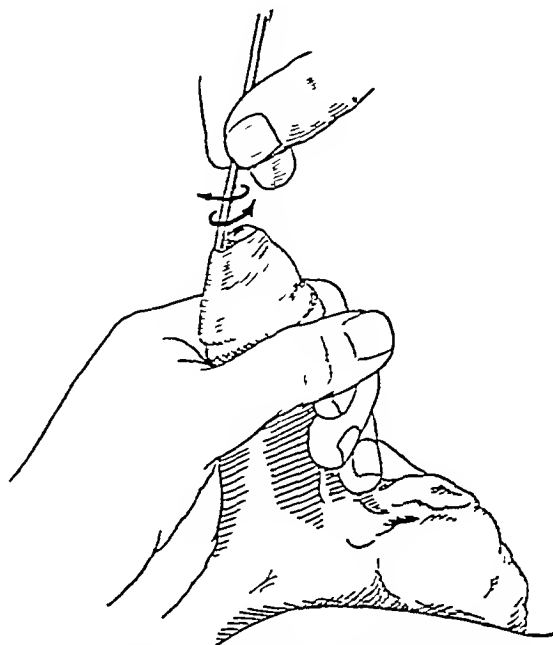


FIG 604—Method of uniting edges of the dorsal slit with interrupted sutures of fine chromic catgut.
FIG 605—Breaking up adhesions between the prepuce and glans with a grooved director preliminary to circumcision, when firm adhesions are present.

sal slit only for redundant prepuce and congenital phimosis and do not follow this procedure, later, by a circumcision.

CIRCUMCISION

Circumcision has been practiced as a ritual by practically all races except those of Western Europe. It was practiced long before the Hebrews, who developed this rite from the Egyptians. It is indicated for congenital phimosis and for a long redundant prepuce which interferes with urination and allows smegma to collect. Circumcision is definitely indicated in order to prevent the irritation of the inflamed preputial mucosa in recurrent attacks of balanoposthitis and also to prevent the irritation which plays an important rôle in favoring the formation of papillomata (venereal warts).

The success of the operation (there are many procedures) depends upon the removal of more skin than mucosa. Adhesions of varying degrees are frequently met with in congenital phimosis. In infants and in young children, they can usually be broken up with a grooved director (Fig 605). In older children and in adults, it is often difficult to separate the adhesions and at times, the glans is injured in separating them. The adhesions must be separated in order that the operation be successful.

For children under the age of twelve, general anesthesia is practically always necessary

Circumcision should never be performed in the presence of an active infection, such as acute gonorrhea, chancroids and acute balanoposthitis. If some relief for phimosis or paraphimosis is necessary a dorsal slit (Figs 603 and 604) should be done and circumcision later when the infection has subsided

Local Anesthesia. A 1 per cent novocain without adrenalin is satisfactory. The anesthesia consists of circular block anesthesia. The anesthetic is injected around the penis close to its base (Fig 166) and then both corpora cavernosa are injected with a few cubic centimeters in order to anesthetize the mucosa. Occasionally hemorrhage and even infection of the corpora cavernosa may result from their injection

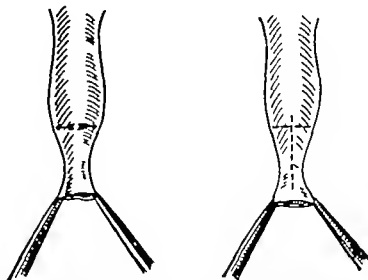


FIG. 606—Step 1 of circumcision by the dorsal slit method. The edges of the prepuce are grasped by forceps at the mucocutaneous junction. The vertical dotted line indicates the dorsal slit and the transverse double arrow or dotted line indicates where prepuce should be divided at level of base of glans penis

The mucosa is often not satisfactorily anesthetized in this manner and it is necessary to infiltrate it directly. The mucosa should be anesthetized completely

A constrictor is then placed at the base of the penis and tightened. This prevents rapid absorption of the anesthetic and controls bleeding during part of the operation. Following the circumcision and before sutures are applied the constrictor is loosened in order that active bleeders can be ligated. In the clamp method or in the circular bloodless circumcision the constrictor is unnecessary



FIG. 607—Step 2 of circumcision by the dorsal slit method. Trimming edges of prepuce so that the skin flap is divided at a higher level than is that of the mucosa, so latter will be everted when healing occurs.

There are in the main three methods¹ of performing circumcision which may be modified slightly by the operator

1 CLAMP AND CIRCUMCISION The prepuce is caught at the mucocutaneous junction (Fig 606). A long straight forceps is then clamped over the stretched prepuce on each side beyond the glans penis. The distal part of prepuce which has been clamped, is cut away with a scissors. The forceps are removed. The skin

In children with adherent prepuce it is usually best to break up the adhesions (Fig 605)

slips back but sufficient mucosa has not been removed. The mucosa is now trimmed around up to the desired length. All bleeders are ligated and four to six catgut sutures are inserted uniting mucosa and skin.

2 CIRCULAR BLOODLESS CUFF CIRCUMCISION In this operation, an incision is made in the mucosa circularly, one-sixth to one-eighth of an inch from the glans, and a similar circular incision is made on the skin at the margin of the corona. Both incisions are made with a scalpel. The mucosa and skin are now dissected upward without cutting or injuring the blood vessels in the subcutaneous tissues and submucosa. When properly done, there is very little hemorrhage and a good functional result follows. The mucosa must be dissected away after the clamp is removed. In the circular circumcision one finds that the operation takes longer and except for less injury to the blood vessels, it is not as satisfactory as the dorsal

FIG 608

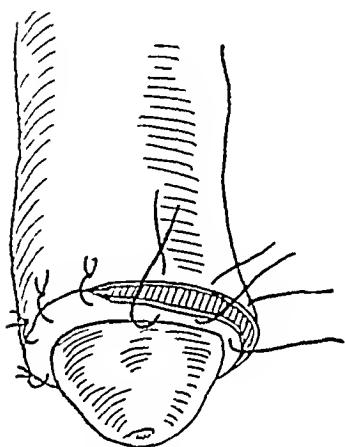


FIG 609

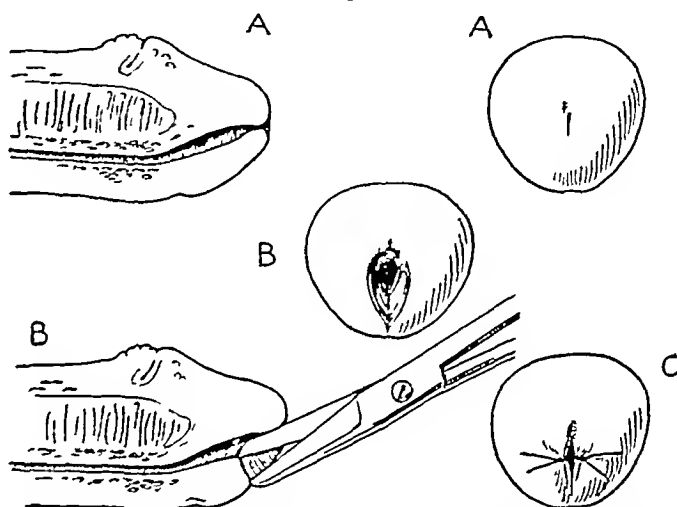


FIG 608—Step 3 of circumcision by the dorsal slit method (compare with Figs 606 and 607). Note how mucosa is everted because level of division of the skin is higher than is that of the inner layer of the prepuce.

FIG 609—Technic of meatotomy.

A Sagittal section and frontal view of penis showing very narrow external meatus.

B Sagittal and frontal view of incision along lower margin of external meatus.

C Sutures (catgut) uniting edges of urethral mucosa and skin. Note larger caliber of meatus.

slit and circumcision. In all operations, it is necessary, in order to obtain a successful end result, to remove the mucosa up to one-fourth to one-eighth of an inch from the corona.

3 DORSAL SLIT AND CIRCUMCISION A forceps (Fig 606) is placed on each side of the median line on the dorsal surface of the prepuce at the mucocutaneous junction, another pair is placed, one on each side of the frenulum at the mucocutaneous junction of the prepuce. A dorsal slit (Fig 607) is now made, the mucosa being incised the required distance. A second slit is now made first, on one side beginning at the frenulum and descending downward and outward, then extending circularly to meet with the dorsal incision (Fig 607) and in this way one-half of the prepuce is removed. The other half is now removed in the same manner.

All bleeders should be immediately ligated. Bleeding from the frenular artery should be particularly looked for. From four to six catgut sutures (Fig 608) are sufficient to unite the mucosa and skin.

A gauze dressing covered with vaseline is kept firmly applied to the wound for the first twenty four hours. However if applied too firmly considerable edema of the glans penis will result.

MEATOTOMY

The congenitally narrow meatus is an etiologic factor in the persistence of infection in the anterior urethra. About fifty per cent of men suffering with a chronic anterior urethritis have a narrow meatus and it is evident that poor drainage and failure properly to flush the urethra through the narrow meatus may be a cause for the persistence of infection.

The meatus may also become narrow as the result of infection or ulceration. Chronic meatitis may produce a narrow meatus as the result of formation of scar tissue. Ulceration at the meatus particularly chancroids may produce considerable scarring and leave a pin-point meatus. With phagedenic ulceration and destruction of the glans it is often difficult to locate the extremely narrow meatus. These acquired strictures at the meatus require meatotomy and frequent dilatation, later in order to prevent recontraction.

In the presence of a chronic anterior urethritis or stricture dilatation is impossible if the meatus only permits the passage of a No. 18 or 20 sound with difficulty. A straight anterior Kollman dilator or short sounds (Fig. 80) can be employed when the patient will not submit to meatotomy. The passage of a cystoscope is not infrequently found to be difficult or impossible, because of a narrow meatus so that meatotomy is often a preliminary to cystoscopy.

Anesthesia. A one per cent novocain solution is injected into the urethral mucosa at the meatus on its ventral aspect and then the solution is injected into the entire balanic portion of the urethra.

THE INCISION is made toward the ventral surface (Fig. 609) of the urethra and not dorsally. A curved bistoury or a scissors is inserted into the meatus down to the fossa navicularis. The meatus is divided the desired width and one half inch of the balanic portion of the urethra i.e., of the mental portion within the glans is also divided.

IF THE MEATUS IS ONLY SUPERFICIALLY DIVIDED WITHOUT INCISING THE DEEPER PORTION THE RESULT WILL BE ONLY PARTLY SATISFACTORY.

Sounds or meatus dilators (Fig. 80) are passed immediately following the meatotomy to determine whether one has obtained the proper degree of dilatation. If not sufficiently cut, the meatus can be cut further until a satisfactory caliber is attained.

THE MEATUS SHOULD NOT BE ENLARGED BEYOND 31 OR 32 F. This will allow for some contraction following healing the passage of a 28 or 29 sound being large enough for dilatation. We do not at present dilate to 35 or 38 as has been done in the past.

The meatus should not be cut too wide because some narrowing at the meatus is necessary to give some force to the stream. When cut too wide the stream has no force and splashes out. In some cases the condition may resemble externally that of hypospadias.

SUTURES CAN BE INSERTED following meatotomy (Fig. 609) one at the lower angle of the cut and one on each side uniting the mucosa of the glans and urethra thus preventing hemorrhage and re-contraction. When sutures are not inserted

a sound should be passed daily for the first week or ten days to prevent healing of the cut and re-contraction. A small pledget of cotton inserted in the incision at the meatus and covered by vaseline often helps to control the slight amount of bleeding following operation.

URETHROTOMY

INTERNAL URETHROTOMY

This is an operation which was popular toward the end of the last century, but is rarely employed now.

Otis and his followers calibrated the urethra with a urethrometer and arbitrarily determined what they thought was the necessary width of the urethra. Thus, urethrotomy was often performed for so-called strictures of wide caliber, which are not an indication for urethrotomy at the present time. The normal caliber of the urethra varies considerably with narrowings and dilatations at various points.

Indications Most strictures that require incision are located in the bulbomembranous urethra or slightly above, so that the vast majority of the strictures that could be cut with a urethrotome can be incised through an external urethrotomy incision when one operates for strictures at the bulbomembranous junction.

THE ENTIRE LENGTH OF THE URETHRA IS INCISED in internal urethrotomy, so that for months afterward, there is incurvation and twisting of the penis on erection. This usually clears up, but is sometimes permanent, due to scar tissue in the corpora cavernosa. Internal urethrotomy should be limited to the anterior urethra only. Internal urethrotomy of the bulbomembranous urethra will result in urinary infiltration, due to the fact that this portion of the urethra is not as well protected. Therefore external urethrotomy is always indicated for strictures of the bulbomembranous urethra.

The operation can be done under either local or general anesthesia and some have performed it in the office. It is best done under general anesthesia in a hospital.

ALL INCISIONS IN INTERNAL URETHROTOMY ARE MADE DORSALLY, toward the corpora cavernosa and corpus spongiosum. Ventral incision will cut through the urethra externally and produce a permanent fistula, because the urethra has few enveloping structures.

TWO TYPES OF INSTRUMENTS ARE EMPLOYED FOR INTERNAL URETHROTOMY. The Otis urethrotome for strictures of caliber 15 or more and the Maisonneuve for filiform strictures.

With the Otis instrument, the tip of the instrument is passed beyond the stricture. The instrument is then dilated to the desired size and the blade pulled forward to divide the stricture. The blade is then returned in place, the urethrotome screwed back to normal and removed. This is repeated until all strictures have been cut.

With the Maisonneuve, a filiform is inserted and the stricture cut from before backward, rather than from below upward, as with the Otis urethrotome. The entire urethra is cut by pulling the blade forward.

The Otis urethrotome is sometimes used in conjunction with external urethrotomy. In some cases, the urethrotome can be inserted upward through the external

urethrotomy incision for the purpose of cutting the stricture in the anterior urethra. A retention catheter is inserted and left in for a few days following the operation.

EXTERNAL URETHROTOMY

External urethrotomy is performed less often at present than in the past. Although this operation still has its definite indications they are relatively few. Wherever possible strictures should be dilated rather than cut. Many strictures that are even impermeable will gradually respond and allow a filliform to enter and thus later permit the gradual dilatation of the urethra to good proportions without urethrotomy.

Indications. Urethrotomy does not in itself complete the treatment for stricture. It is preliminary to dilatation. Strictures that cannot be otherwise dilated are cut, thus permitting the passage of larger sounds for dilatation.

RELAPSING OR ELASTIC STRICTURES which in spite of the ability to dilate recontract immediately after sounding require urethrotomy. The neuralgic and hemorrhagic stricture that is very sensitive and bleeds easily with dilatation should also be operated.

MARKED PERIURETHRITIS with a tight stricture of the posterior urethra is an indication for urethrotomy. Per urethral abscess and fistula in the perineum are nearly always associated with a stricture and urethrotomy is always necessary in order to cure the abscess and fistula.

URINARY EXTRAVASATION due to a tear or ulceration of the urethra, secondary to stricture requires a urethrotomy. Filliform strictures that do not respond rapidly and those in which the subacute urinary retention is not relieved had best be urethrotomized.

AFTER TREATMENT External urethrotomy is performed for strictures located at the junction of the bulbous and membranous portions of the urethra (Fig. 610). Within four to five days following the urethrotomy dilatation with sounds should be undertaken and then continued at gradually decreasing intervals, as mentioned in treatment of stricture of the urethra. Strictures that have been incised require dilatation at intervals over many years equally as much as those that have not been cut.

If external urethrotomy is not followed by routine dilatation or only a few dilatations, the stricture will re-contract. The scar due to the operation superimposes a traumatic stricture upon the gonorrheal stricture and if dilatation is not performed at the proper time the tough fibrous stricture which results will not be

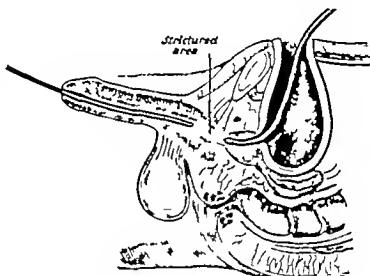


FIG. 610.—Retrograde use of a special (Legueu) sound so as to locate urethra in cases of external urethrotomy without a guide (After Legueu and Papin)

dilatable The indication for external urethrotomy is, as has been previously stated, inability to dilate the stricture

Anesthesia The operation should be performed under general anesthesia, if extensive dissection in the perineum is required Caudal anesthesia, however, suffices for most uncomplicated cases

The operation is quite simple if a guide can be passed into the urethra Even a filiform is sufficient to guide the operator

An impermeable stricture can, in most cases, be operated upon successfully through a perineal incision, if the operator is patient and careful It is seldom necessary to do a suprapubic cystotomy and pass a guide through the urethra from above (Fig 610), to locate the stricture A sound is usually passed through the urethra and in this way the stricture can be located

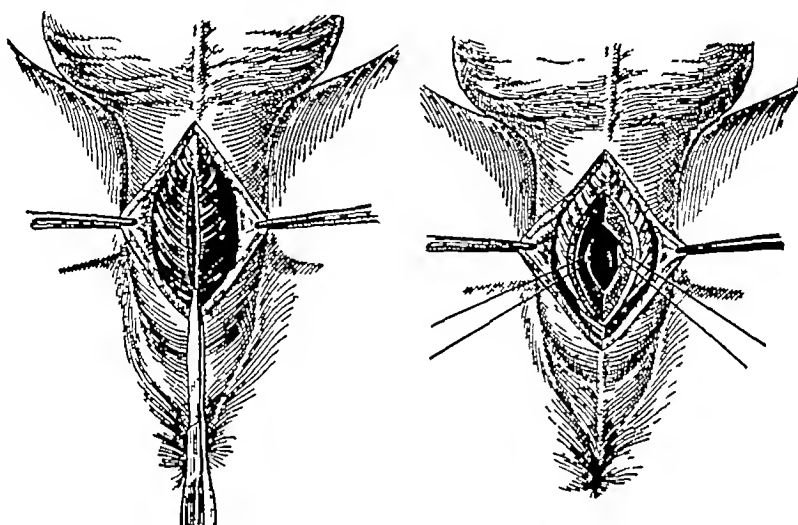


FIG 611—External urethrotomy The illustration on the left shows how bulb is divided in midline while a grooved sound or filiform in the lumen of the urethra is held firmly against the perineum

On the right note how urethra has been divided over guide and edges of urethral mucosa held apart by traction sutures (After Duval)

The patient is placed in the lithotomy position, the buttocks brought down over the edge of the table, so that the urethra is in the median line

Urethrotomy with a Guide A sound, preferably grooved, is inserted through the meatus and passed into the bladder If a filiform only is passable, this is introduced through the stricture The sound is then partly withdrawn and held firmly in the median line by an assistant so that it projects in the perineum The scrotum is pulled up and either held up by the assistant or tenaculum forceps applied to keep it up

AN INCISION IS NOW MADE IN THE MEDIAN LINE OVER THE SOUND (Fig 611), beginning at the perineoscrotal junction and continuing downward to a point 3-4 cm from the anus The incision is continued and cuts through the central tendon and extends to the urethra The urethra is incised at its most prominent point (Fig 611) and the incision then extended upward cutting through the bulb The sound is removed and an Otis Gorget is introduced (Fig 614) through the incision in the urethra, into the bladder Strictures a little higher up in front of the bulb, are split with a bistoury inserted in a distal direction (Fig 613) in the urethra

A 29 OR 30 FRENCH SOUND IS INTRODUCED THROUGH THE MEATUS AND IF THIS

PASSES SUCCESSFULLY INTO THE BLADDER THE GROOVED DIRECTOR STILL BEING IN PLACE THE OPERATION CAN BE CONSIDERED COMPLETED. A large rubber catheter or a rubber tube (Fig. 613) is inserted through the perineal incision into the bladder and the grooved director which has acted as a guide is removed. The catheter is manipulated and the bladder injected through it so that the urine flows through it freely. The muscles are united by suture the catheter is held in place with silk worm gut and the skin sutured. A compression bandage is applied to the perineum. The retention catheter in the perineum is removed within four to five days. On the sixth day, a 21 or 23 sound is passed.

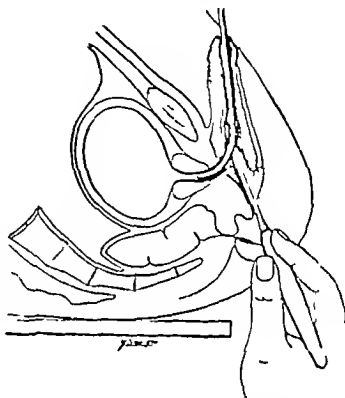


FIG. 612.—External internal urethrotomy. The knife is turned and pushed along the groove of the guide toward the meatus as nearly parallel to its shaft as possible in order to cut any stricture just distal to the incision. (Guthrie, Urology, D. Appleton Co.)

It is unnecessary to leave an indwelling catheter through the entire lumen of the urethra after the operation because the urethra will regenerate rapidly if only given a fair chance. A sound should be passed early because scar tissue forms rapidly and tends to contract. After the first dilatation sounds can be passed every three to four days for the next three or four weeks then less often.

If only a filiform can be passed before the external urethrotomy, either a LeFort follow up (Fig. 79) or a Banks bougie (Fig. 201) can be inserted so that it is caught at the point of stricture and the incision in the urethra made at this point and then continued along the filiform. The operation is then completed as given above.

Urethrotomy Without a Guide. A sound or bougie is inserted through the meatus and passed into the urethra as far as it can go. An incision is made in the perineum and the urethra incised over the tip of the sound above the stricture. Each lip of the urethra is caught with an artery forceps or

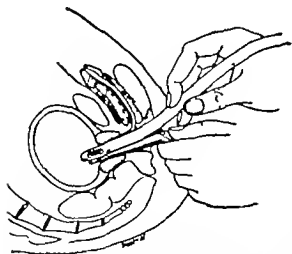


FIG. 613.—External internal urethrotomy. The perineal tube is passed along the gorgut into the bladder and any urine present, escapes through the tube. (Guthrie, Urology, D. Appleton Co.)

traction suture (Fig. 611), and the staff is removed.

The operator inserts a fine probe through the incision into the urethra and after the probe has passed some distance, the urethra is divided over it and another pair of artery forceps are placed, one on each side, over this additional incision. The stricture continues to be probed in this way and then incised, and the mucosa caught with forceps, until the entire area is cut through. The bulb is, of course, cut through. Although there is some hemorrhage after division of the bulb, it can always be controlled and the painful erections that sometimes follow incision of the bulb, nearly always disappear, after some time.

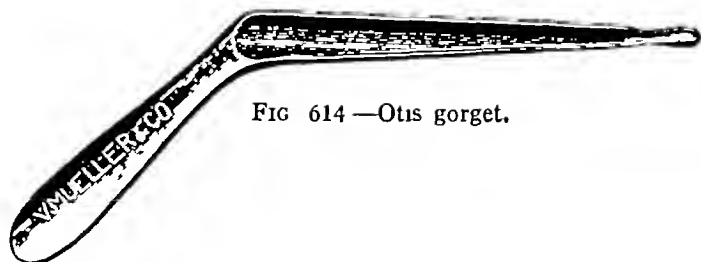


FIG 614 —Otis gorget.

The strictured area should be dissected out carefully. If this is not done, the operation is often a failure, fistulous tracts very frequently persisting. Following complete division of the stricture, the operation is continued as in external urethrotomy with a guide.

Resection of the urethra is rarely necessary and is only indicated for extensive scarring due to traumatic stricture or long standing fistulae.

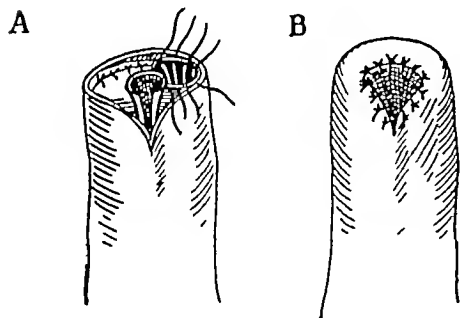


FIG 615 —Low amputation of the penis

A After a racquet shaped incision through the skin and transverse division of the corpora cavernosa and urethra, the latter are closed by interrupted sutures through the fascia enclosing them. The urethra is slit vertically along its lower edge.

B The skin edges are united to those of the slit urethra. (After Duval)

AMPUTATION OF THE PENIS

Practically the only indication for this operation is cancer. If the lesion is a very early one and confined to the prepuce with moderate involvement of the glans, a low amputation is still feasible, if there are no palpable inguinal glands.

This low amputation is performed as follows:

(a) A narrow rubber tube is applied around the base of the penis as a constrictor.

(b) A racquet shaped incision is made through the skin at least one inch (2.5 cm) proximal to the base of the glans penis (A of Fig 615).

(c) The corpora cavernosa are divided transversely at a higher level than the skin, and the edges of the cut surface united with chromic catgut sutures (A of Fig 615).

(d) The corpus spongiosum and urethra are also divided transversely (A of Fig 615) and a slit made along the ventral (posterior) aspect of the urethra so as to avoid postoperative contraction of the new external meatus (A of Fig 615). The edges of the skin incision are next united so as to cover the surfaces of the previously closed corpora cavernosa (B of Fig 615). The edges of the slit mucosa of the urethra are finally approximated with chromic catgut sutures to the skin edges (B of Fig 615) and the rubber tube constrictor removed.

RADICAL OPERATION FOR CARCINOMA OF THE PENIS

Block removal of the penis and the glands of the inguinal region of both sides, with all of the intervening lymphatics (Fig 54) The tumor itself is enveloped in gauze saturated with some antiseptic solution such as one per cent mercurochrome Usually it is only necessary to divide the penis at its base and not to excise the deeper portions of the corpora cavernosa and bulb We prefer to begin with a complete removal of all of the subcutaneous fat and glands of the pubic and of both inguinal regions down to the aponeurosis of the external oblique on both sides The dissection should also include all of the glands and fat over Scarpa's triangle The block dissection should begin from above and be car-

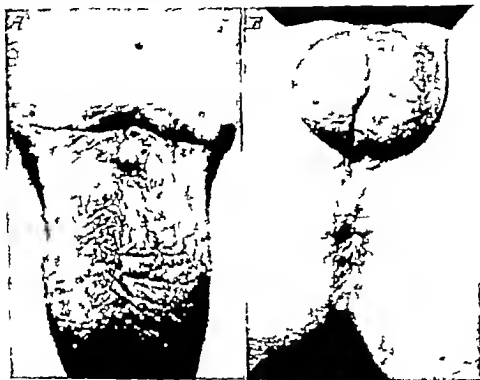


FIG. 616—A. Appearance of suprapubic incision following amputation of penis for carcinoma
B The opening of the urethra is visible close to the perineoscrotal junction

ried downward and inward (Fig 579) toward the penis. It is unnecessary to sacrifice the testes Having divided the various structures at the base of the penis (skin corpora cavernosa and corpus spongiosum with the urethra) the corpora cavernosa are then drawn together (Fig 616) and the skin closed (Fig 616) after dividing the urethra with a dorsal incision so as to prevent stricture of the new meatus (Fig 616) Ample provision for drainage of both inguinal regions must be made This operation is a block dissection of all of the territory in which the lymphatics of the penis (Fig 54) are found as well as of the primary tumor

HYPOSPADIAS

In the vast majority of cases of hypospadias the opening is located at the glans or immediately below it (Figs. 223 and 224) These do not require operative interference and are better left undisturbed Cases of penile scrotal and perineal hypospadias (Fig 224) require correction Hypospadias does not occur posterior to the bulbous urethra. It only involves the anterior urethra

Many procedures have been devised and recommended for the relief of penoscrotal and perineal hypospadias. There is, however, no operation which is satisfactory for all cases.

The operation is essentially a plastic one, its object being to straighten the penis and reconstruct the urethra.

All of the operations aim to produce a urethra by means of flaps or grafts.

Pre-Operative Treatment

1 PENIS STRAIGHTENED Before an attempt is made to do plastic work on the urethra the first step in all operations must consist in an attempt to straighten the incurvation of the penis. The penis is often held down or attached to the scrotum and transverse incisions are made to free the penis from the scrotum. It may be necessary at times to incise the corpora cavernosa also. The incisions

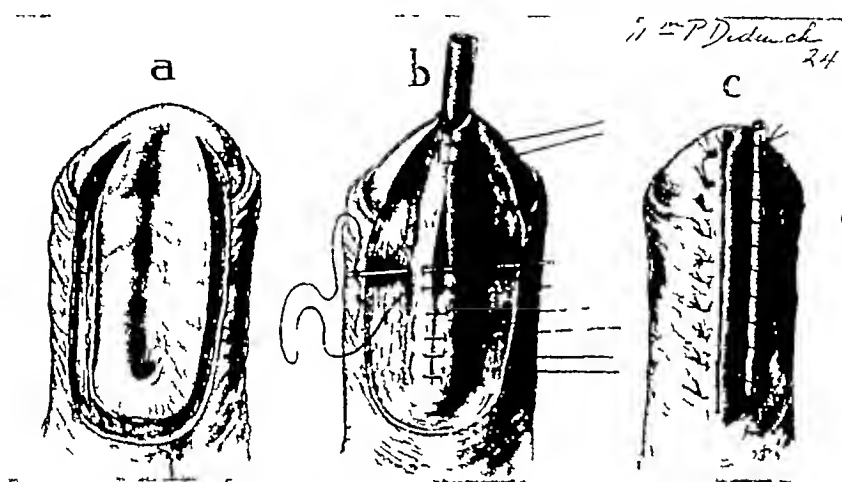


FIG 617—Glandular penile hypospadias. Closure by method of Duplay, but using removable mattress silk sutures.

A Wide skin incision

B Formation of tube

C Closure, ligatures tied around a rubber tube (Young's Urology, W B Saunders Co)

are then united by sutures in a vertical direction and the penis held extended, while healing. Four to six months must be allowed to elapse before any further plastic work on the urethra is attempted.

2 DIVERSION OF THE URINE by means of a perineal urethrotomy or suprapubic cystotomy and inserting a tube through the incision in the bladder until the plastic work is completed, is often essential to the success of any of the various operations.

Duplay's Operation (Fig 623) An incision is made on the ventral (inferior) surface of the penis parallel to its long axis, about 8 mm from the midline on each side and extending from the summit of the glans to the hypospadiac orifice. At each extremity of this incision, others are made at right angles extending outward about 6 mm. The flap thus formed is dissected outward. Shorter incisions from each extremity of the long incision are made extending outward toward the median line and produce a flap dissected inward. These inner flaps are dissected around and sutured together over a catheter and form the inner layer of the urethra. The outer flaps are then drawn together and form the outer covering of the urethra.

The perineal fistula is closed after the operation has completely healed and

the catheter is inserted through into the bladder from the meatus for a few days and then removed

In Beck's operation use is made of flaps derived from the penis and scrotum In the Nove-Jusserand operation the plastic work is done by tunnelling and the use of grafts

The danger of slough with any of the operations is always present. Avoidance of tension preserving circulation to the flaps and asepsis are all necessary for the success of the procedure

In the Ombredanne operation a flap of skin from the prepuce penis or scrotum is turned up in the form of a pouch in successive stages to construct the urethra No diversion of the stream is necessary This procedure has become popular in recent years

EPISPADIAS

This condition which is the opposite of hypospadias is usually associated with exstrophy of the bladder but also occurs independently These patients are usually incontinent Young's operation is the most satisfactory and consists of reconstruction of the vesical sphincters in order to restore continence and repair of the urethra in a manner similar to that of the Beck operation for hypospadias.

CHAPTER 49

OPERATIONS ON THE PROSTATE AND SEMINAL VESICLES

PROSTATECTOMY

YOUNG TECHNIC OF PERINEAL PROSTATECTOMY

SUPRAPUBIC PROSTATECTOMY

LATE COMPLICATIONS OF PROSTATECTOMY

OPERATIONS FOR CARCINOMA OF THE PROSTATE

OPERATIONS ON THE TRIGONE

TRANSURETHRAL RESECTION OF THE PROSTATE AND OTHER BLADDER-NECK OBSTRUCTIONS

PROSTATOTOMY

OPERATIONS ON THE SEMINAL VESICLES

VESICULOTOMY

PROSTATECTOMY

YOUNG TECHNIC OF PERINEAL PROSTATECTOMY

A special urologic operating table with adjustable leg supports and an automatic perineal elevator permits placing the patient in an exaggerated lithotomy position so that the plane of the perineum is as nearly horizontal as possible. Imperfect position makes the operation a much more difficult one. When the patient is in proper position, a No. 24 sound is passed by the operator until he is certain that the beak is well within the prostatic urethra, when the handle of the sound is given to an assistant.

FIG 618

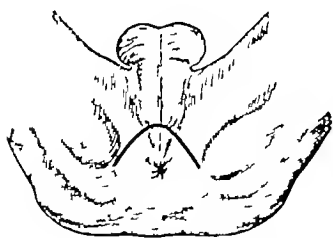


FIG 619

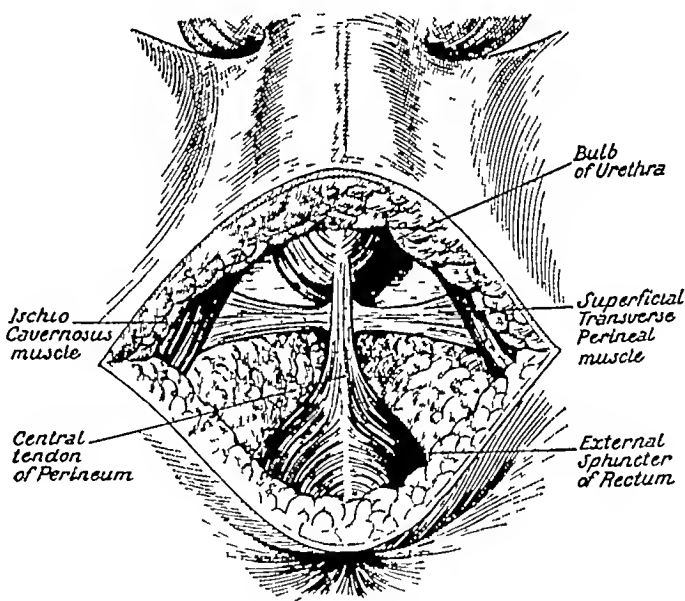


FIG 618—Skin incision employed by Young for prostatectomy (perineal)

FIG 619—Perineal prostatectomy. Dissection to show position of transversus perinei muscles and of bulbous portion of the urethra

The perineal incision (Fig 618) is in the form of an inverted U, the apex being one and a half inches in front of the anus and the two branches running backward within the ischiopubic ramus for a distance of about two inches on each side. This incision is carried through skin, fat, and subcutaneous fascia. The bulb is exposed (Fig 619) but not opened.

By BLUNT DISSECTION with the finger and handle of the scalpel (Fig 620), the space behind the transversus perinei muscles (Fig 619) on each side of the central tendon and in front of the levator ani muscles is opened up. In introducing the finger, great care is taken so that it shall be directed slightly upward and

forward to avoid going toward the rectum the operator being sure that the line of dissection is back of the triangular ligament on each side. The lateral spaces having thus been opened up, a special bifid retractor facilitates the next step by making traction upon the central tendon and thus drawing the bulb well up into view (Fig 621) and at the same time pushing the rectum back out of the way.

SHARP DISSECTION The operator then cuts across the central tendon (Fig 621) close to its attachment anteriorly to the bulb until the region of the recto-urethralis muscle is reached. At this point it is best to remove the bifid retrac-



FIG. 620.—Young's perineal prostatectomy opening up space on each side of central tendon by blunt dissection with finger assisted by handle of scalpel. Operator careful to go behind transversus perinei muscles and triangular ligament. (See Fig. 584.) (Young's Practice of Urology W. B. Saunders Co.)

tor and insert a small simple retractor (without a posterior lip which might injure the rectum) and thus make taut the recto-urethralis muscle (Fig 622) which running from the rectum to the membranous urethra and triangular ligament produces the anterior pouch of the rectum. This muscle covers the membranous urethra (Fig 622) and great care must be taken to get a good exposure and to divide the muscle well forward (Fig 623) so as to avoid injury to the rectum which can be pulled backward by blunt dissection with the handle of the scalpel thus exposing the membranous urethra and apex of the prostate. By the use of a special grooved retractor which is so constructed as to encircle the membranous urethra anterior traction draws forward the triangular ligament and

most of the fibers of the external sphincter (Fig 622) With care the operator is able to push forward the remaining circular muscle fibers and to push back the rectum sufficiently so as to expose a small area of the apex of the prostate and to make an incision upon the urethral sound, through the membranous urethra where it joins the prostate, thus carrying out a urethrotomy entirely behind the external sphincter and effectively guarding against postoperative incontinence (Fig 624) The edges of the urethrotomy incision are then picked up with Allis

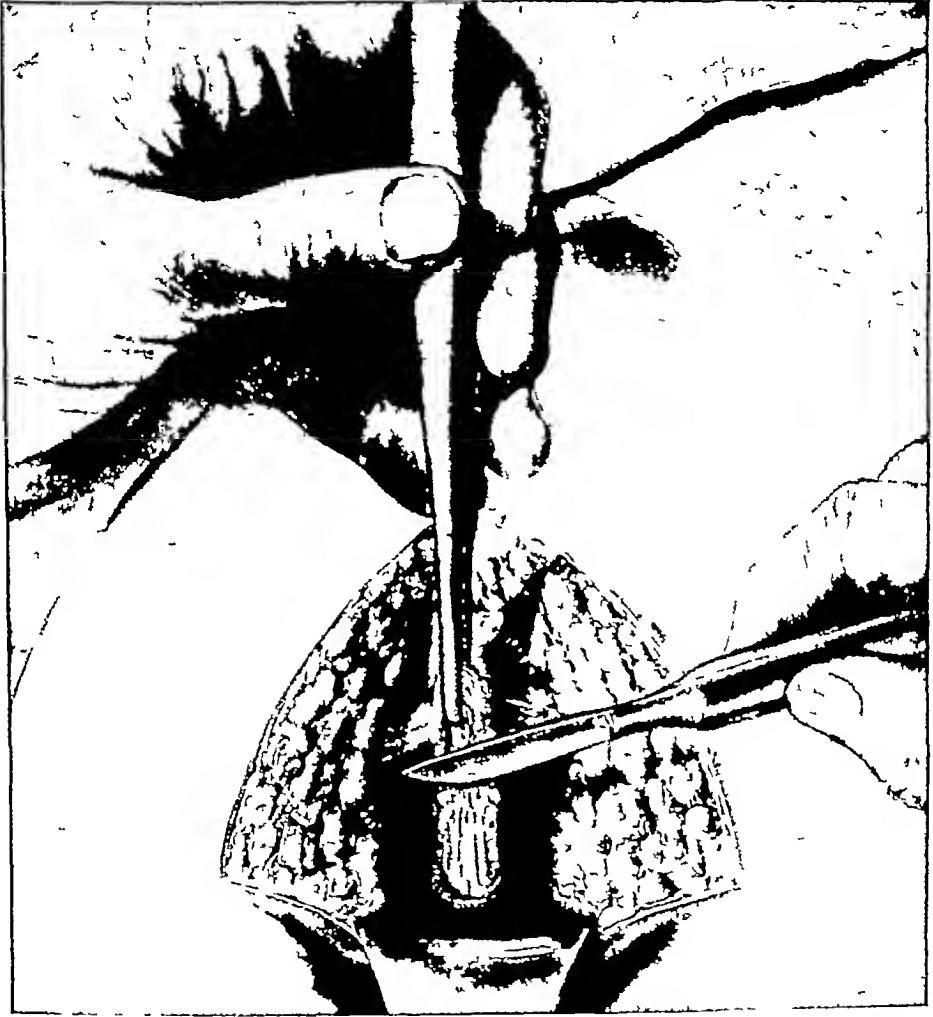


FIG 621—Young's perineal prostatectomy. Traction made with bifid retractor. Division of central tendon just behind bulb (Young's Practice of Urology W B Saunders Co)

clamps (Fig 665), the operator being certain that the mucous membrane is engaged, after which the sound is removed from the urethra. A straight sound is passed through the urethrotomy incision into the bladder (to make sure that the passage is clear). The prostatic tractor (Fig 625) is then introduced through the urethrotomy incision into the bladder, opened out and traction (Fig 626) made. In this way the prostate is brought much closer to the perineum and an inspection will generally show that it is still covered by a fibromuscular layer through which it is necessary to go before the capsule is reached. In fetal life the peritoneum extends down almost to the perineum, but subsequently these two layers become approximated (Fig 41) to form the anterior and posterior layers of Denonvillier's fascia (Fig 626). Between these two layers lies the route

for the proper exposure of the prostate and seminal vesicles. This part of the operation is the most important as to detail for if the operator does not satisfactorily divide the posterior layer of Denonvillier's fascia and attempts to push the rectum back before so doing it is not difficult to penetrate the rectum. Practically all injuries of the rectum during perineal prostatectomy are due to such a failure in technic. In order therefore to be sufficiently careful it is advisable while drawing the prostate up into the wound with the tractor (Fig 625) to make an incision on each side upon the apex of the prostate and push back the tissues carefully until the pearly white anterior layer of Denonvillier's fascia which closely covers and in reality forms part of the prostatic capsule is reached. As soon as it is exposed on either side, it is quite easy to follow this white covering of the prostate across to the



FIG 622—Sagittal section of adult pelvis showing diagrammatically the relation existing between the external vesical sphincter (EVS) and the rectourethralis muscle (RU) (Courtesy of Dr. Miley B. Wesson.)

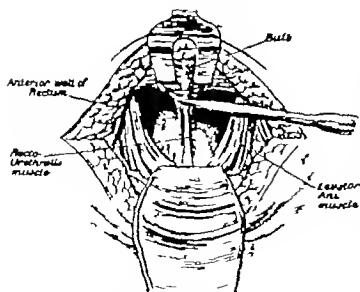


FIG. 623—Young's perineal prostatectomy showing division of rectourethralis muscle

other side and to divide fibers running to the rectum, which is then very easily pushed backward by blunt dissection. A posterior retractor, which is slightly curved not too deep and has no posterior lip is then carefully introduced in front of the posterior layer of Denonvillier's fascia and levator muscles and traction made thus drawing backward the rectum with the central tendon the rectourethralis and levator ani (on each side) muscles. By the use of narrow lateral retractors an excellent view of the entire posterior surface of the prostate can now be obtained (Fig 626). If it is necessary to see the region of the seminal vesicles this can be accomplished by further blunt dissection on each side. In his latest technic

the posterior surface of the prostate can now be obtained (Fig 626). If it is necessary to see the region of the seminal vesicles this can be accomplished by further blunt dissection on each side. In his latest technic

Young¹ makes a single lateral capsular incision almost parallel to the urethra and just external to the verumontanum and ejaculatory ducts. This incision opens the urethra along its left lateral wall to the middle lobe.

THE ENUCLEATION OF THE LATERAL LOBES which was started with the scalpel is completed with the finger, the tractor being carried downward. With the tractor held vertically, beak directed



FIG 624.—Membranous urethra exposed, incised longitudinally upon sound, and edges of urethrotomy incision grasped with Allis clamps (Courtesy of Dr H H Young and W B Saunders Co)

downward, the lateral lobes having been freed, the mucous membrane in front of the middle lobe is divided transversely with a scalpel, the ejaculatory ducts being pushed backwards with the finger.

THE MIDDLE LOBE, attached to the already freed lateral lobes is separated from the sphincter and vesical mucosa and enucleated from behind forward.

It is very important to prevent injury to the rectum. If accidentally entered at the beginning of the operation suture the wound and discontinue the perineal operation. Do a cystotomy and remove the prostate suprapubically later as a second stage procedure. If not discovered early, or if it occurs at the end of the operation, a urethrorectal fistula develops which is very difficult to repair, and often intractable.

Drainage and Packing Until recently, Young employed the Davis modification of the Pilcher bag for the control of bleeding after perineal prostatectomy. During the past few years, however, an attempt is being made to avoid leaving even such an inflatable rubber bag, by substituting sutures inserted, through the edges of the vesical orifice similar to that employed in suprapubic prostatectomy. After the operator has satisfied himself by digital examination within the sphincter that all hypertrophied tissue bars and contracture have been removed and the bladder searched for calculi, a large drainage tube is introduced (and beside it a small gauze pack) within the vesical orifice. The lateral cavities are packed sufficiently tight to stop all hemorrhage. The drainage tube is fastened to the lower angle of the wound on the right side, the gauze packs are brought out in front of the tube and the apex and one angle of the wound closed up, leaving about two thirds of the wound open on one side for drainage and packs.

The technic of this operation has been improved upon recently by making a smaller perineal incision close to the anus, and by exposing the tissues as little as possible. Belt has recommended a procedure which in essence consists of separating all the structures up from the rectum in the approach to the prostate.

Anesthesia for Perineal Prostatectomy Spinal anesthesia is the best

¹ See Modern Urology (edited by Dr Hugh Cabot) 1936, 1, 746, published by Lea and Febiger

for perineal prostatectomy 50 to 75 milligrams of novocain gives satisfactory anesthesia. Caudal anesthesia alone fails in a large percentage of cases. A combination of caudal and gas anesthesia can also be employed.

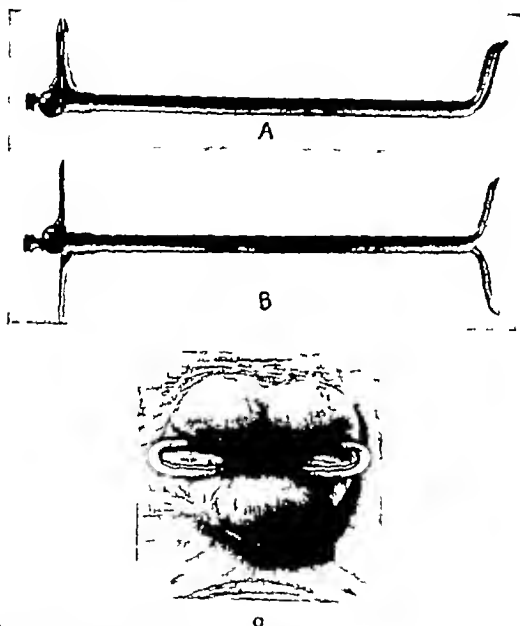


FIG. 625.—Young's prostatic tractor.
 A. Closed.
 B. Opened as after introduction into bladder.
 C. Young's perineal prostatectomy tractor showing position of blades (from within bladder) when prostate is drawn down (Courtesy of Dr. H. H. Young and W. B. Saunders Co.)

SUPRAPUBIC PROSTATECTOMY

The indications for the one step and the two step methods of removal of the prostate through a suprapubic incision have been discussed in Chapter 18 and will not be repeated here.

One-Step Prostatectomy (Open operation under visual guidance) Most urologists in this country prefer the two-stage operation; occasionally a one-stage operation can be done without preliminary catheter drainage. Those who practice one-stage prostatectomy employ an indwelling catheter for some days for preliminary drainage.

TECHNIC Following the injection of 250 cc of sterile water to distend the bladder, the catheter is withdrawn. Some prefer to clamp the distal end of the catheter with an artery forceps or insert a cork into the lumen to prevent the fluid used to distend the bladder from escaping. In spite of such precautions, the patient often expels the catheter and the bladder contents. If this occurs, it is



FIG 626—Young's perineal prostatectomy. Tractor opened out and prostate drawn down. Posterior layer of Denonvillier's fascia pushed back with rectum, exposing the prostate covered with anterior layer of Denonvillier's fascia. Insert shows that in very adherent cases it is only necessary to expose apex of prostate sufficiently to make incisions for enucleation of lobes. (Courtesy of Dr. H. H. Young and W. B. Saunders Co.)

advisable to occlude the urethra, after filling the bladder, with a loop of muslin bandage tied around the penis. We prefer to place the patient in a moderate Trendelenburg position, because it facilitates displacement upwards of the peritoneal fold (Fig 40) and thus to avoid opening of the peritoneal cavity. The technic of suprapubic cystostomy will be described in Chapter 52 (Operations on the Bladder).

AS THE FIRST STEP² in the actual removal of the gland the mucous membrane around the internal urethral orifice or that overlying the intravesical part of the prostate is carefully incised with scissors in order to avoid irregular laceration of the mucous membrane in the subsequent enucleation (Fig. 629). The absence of an anterior lobe favors a cleavage plane for the enucleation in the anteriolateral wall of the prostatic urethra, which may be established by the index finger. The enucleation is then completed with the finger or instrument

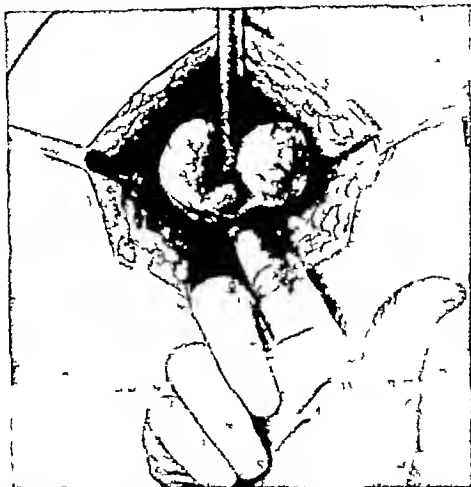


FIG. 627.—Young's perineal prostatectomy. Middle lobe attached to lateral lobes is being separated from sphincter and vesical mucosa. Floor of urethra, verumontanum and ejaculatory ducts lie beneath finger. (Courtesy of Dr. H. H. Young and W. B. Saunders Co.)

throughout the entire circumference within the capsule (Fig. 628). In cases of adenomatous hypertrophy the cleavage plane is very definite and entirely within the capsule³ of the gland. It is most readily established anteriorly and when accurately obtained favors the enucleation of the entire adenomatous enlargement of the median and lateral lobes intact and at times with the entire circumference of the prostatic urethra.

This operation makes possible a careful excision, with scissors, of the gland or its obstructing portion under guidance of the eye.

INSPECTION OF THE PROSTATIC CAPSULE is essential to make sure that small

We are indebted to Dr. Verne C. Hunt for permission to quote from his article (Surg. Gynec. and Obst., 1926, 43: 769) and to the Mayo Clinic for the illustrations (Figs. 628-630 inclusive).

The definition and description of how the normal prostate is displaced laterally to form this surgical or false capsule was taken up in Chapter 18.

adenomata do not persist. Such adenomata have been known to continue to grow and produce obstruction, so that subsequent removal is required.

Hemostasis. Pilcher's modification of the Hagner bag is likewise a most effective method of hemostasis. The bag is usually adequate in controlling bleeding, not only from the capsule but from the vesical neck, as well. Judd and Cabot were the first to advocate interrupted sutures at the vesical neck to control bleeding, and hemostasis is most complete when the sutures are used in conjunction with the bag. Trauma to the urethra by the use of a special sound in the introduction of the bag, is obviated by passing a urethral catheter as a guide for the sound which may be passed before the urethral tube is attached. The urethral tube of the bag is withdrawn, attached to the sound and the bag drawn

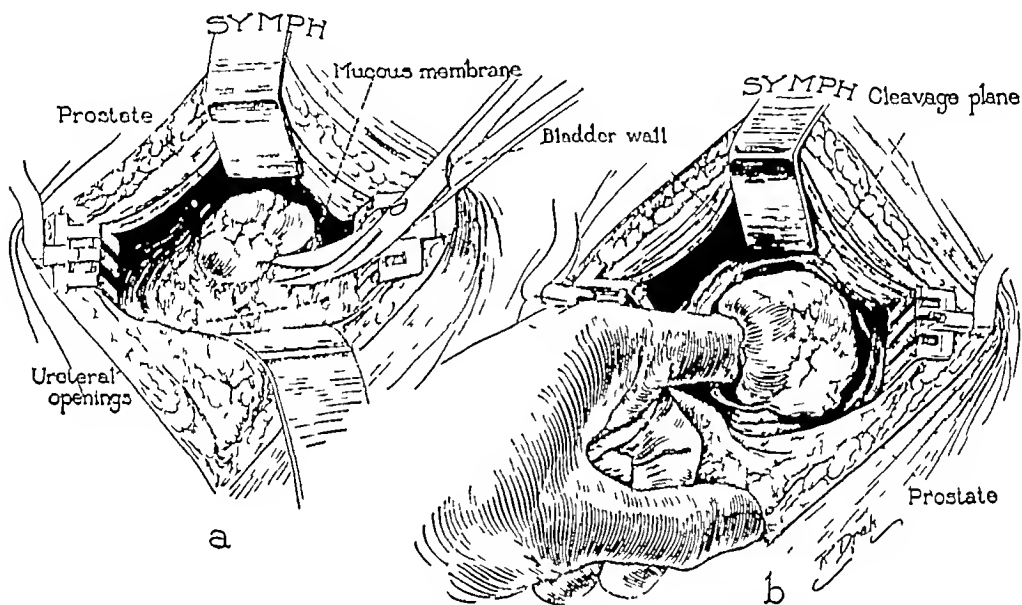


FIG. 628.—One-stage suprapubic prostatectomy under visual guidance. a The mucous membrane around the internal urethral orifice or that overlying the intravesical portion of the gland is incised with scissors in order to avoid irregular laceration of the mucous membrane in the subsequent enucleation, b the cleavage plane in adenomatous hypertrophy of the prostate is established in the anterolateral wall of the prostatic urethra, and is carried about the entire circumference of the gland within the capsule (Courtesy of the Mayo Clinic)

into place, impinging on the vesical neck or internal sphincter, rather than passing entirely into the prostatic capsule, so that it may supplement the sutures, in control of bleeding at the vesical neck, and the traction on the bag may be exerted on the base of the bag at the vesical neck, rather than at the apex of the bag on the external sphincter. The bag is distended with water to the point of complete hemostasis. The amount of distention necessary is not constant, but varies with the size of the prostate and the size of the capsule after removal of the gland. Excessive distention of the bag is not essential to the complete control of bleeding and may exert a harmful effect on the sphincters of the bladder. With complete hemostasis, suprapubic drainage is maintained only while the bag is in position. A No. 30 male catheter provides adequate drainage and allows a sufficient opening on its removal, for the suprapubic withdrawal of the collapsed bag. The traction that is necessary to retain the bag in place may damage the external sphincter and cause incontinence. Although the Pilcher bag is still employed by many, a small gauze packing is preferable, and this, together with

suture of the vesical neck will control bleeding in practically all cases. In the one-stage operation a urethral catheter is usually left in place for 4 to 5 days or until the suprapubic wound closes. The bladder is snugly closed about the suprapubic tube of the bag and catheter with plain catgut the first row approximating the edges of the mucous membrane and the second row approximating the edges of the muscle in the bladder wall. The fascia is closed with chromic

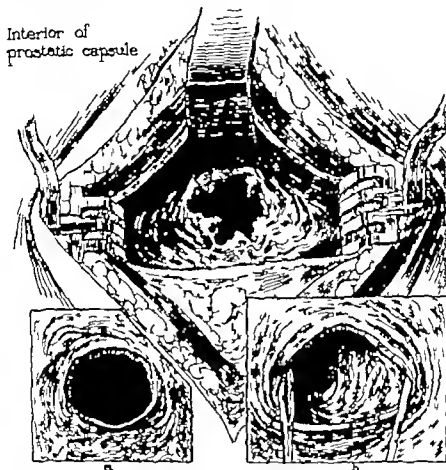


FIG. 629.—Treatment of the vesical defect. In the unexposed operation irregular tags of mucous membrane may persist to become agglutinated and form a diaphragm with subsequent obstruction at the vesical neck. This is obviated by obtaining the exposure of the one-stage operation and incising the mucous membrane with scissors before the enucleation, or trimming off the tags immediately after removal of the gland *a*. At the completion of the operation the neck of the bladder should present a clean cut circumference devoid of irregular laceration or tags of mucous membrane *b*. Inspection of the interior of the prostatic capsule after removal of the gland insures against the oversight of persisting adenomata or fragments of gland tissue. (Courtesy of the Mayo Clinic.)

catgut and the skin and subcutaneous tissues approximated with interrupted silk worm sutures. It is advisable to drain the extravescical space for forty-eight hours with a split rubber tube.

Two-Step Prostatectomy (without Intravesical Inspection) This is the safest and most satisfactory procedure for enucleation of the prostate. The bladder is opened in the manner described in Chapter 52 under Suprapubic Cystotomy. The interval between this first step and that of removal of the prostate must necessarily vary with the local and general condition of the patient as was explained in Chap. 18. A period of 10 days to 2 weeks usually elapses between the cystotomy (which should be done under local anesthesia) and the pros-

tatectomy which can be done rapidly under inhalation anesthesia. It is important that the patient be up and walking for a few days before the prostatectomy. The advantages of the two-stage operation are evident. The prostate shrinks in size, infection is better controlled, and hemostasis is much easier than after the one-stage procedure.

With as little reopening as possible of the granulating opening in the abdominal wall and perivesical tissues, one finger is inserted into the bladder. Having located the internal urethral opening, the mucous membrane just behind its lower border is broken through with the index finger on the side nearest

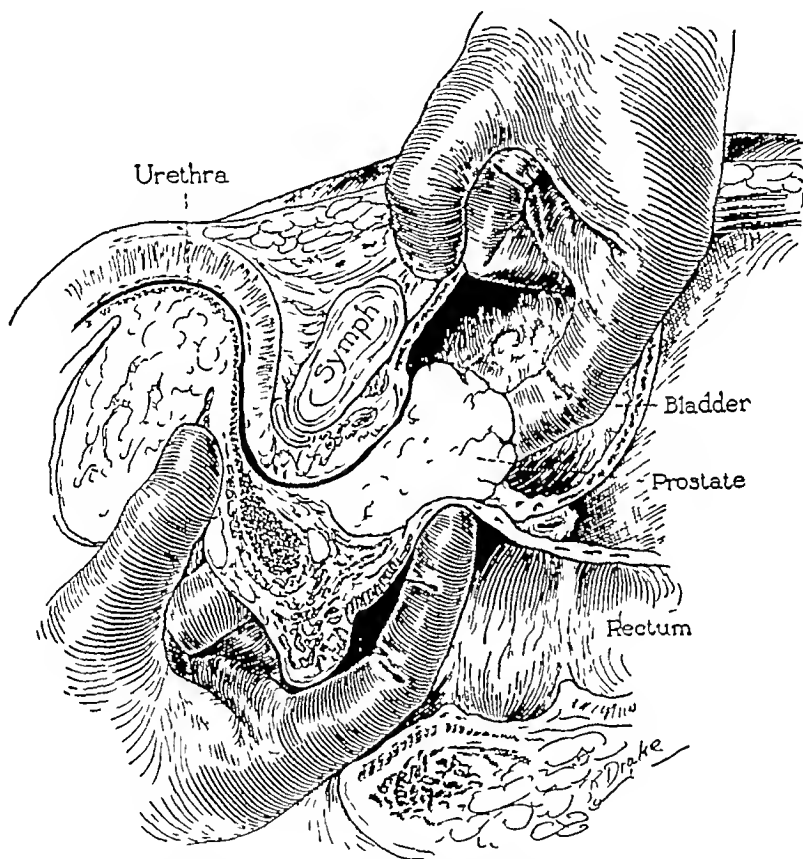


FIG 630—Bimanual prostatectomy following previous cystostomy. The index finger of the right hand in the anus elevates the gland for digital enucleation with the index finger of the left hand. This is necessary only in the two-stage operation, and facilitates the procedure in lieu of exposure. (Courtesy of Dr V C Hunt of the Mayo Clinic.)

the operator, and the intracapsular enucleation continues. If a large middle lobe exists, the enucleation begins along the line of junction of its posterior border with the trigone. If much resistance is encountered, a long sharp-pointed scissors is used. We have also found that one finger (index) introduced into the rectum, aids greatly (Fig 630) in lifting up the prostate. The simplest procedure is by sweeping movements of one or two fingers, introduced through the suprapubic incision, to enter the line of cleavage between the adenomatous prostate and the "surgical" capsule (see Chap 18). In some cases, the adhesions along the posterolateral aspects of the lateral lobes with the posterior commissure and adjacent perirectal and perivesicular (seminal) tissues, are very firm. It is in such cases that one can appreciate the aid given by a gloved finger lifting up the prostatic bed from its rectal side (Fig 630).

After the enucleation of the lateral and middle lobes of the prostate has been completed, the specimen should be examined grossly to see whether it has a smooth surface or is nodular, that is, presents many adenomatous elevations. It is in the latter class of cases, that small adenomata may remain attached to the inner aspect of the prostatic bed, hence it should be a routine procedure before any attempt is made to check the bleeding, to palpate every portion of the bed for adherent adenomata, in order to avoid recurrences or reformation as far as possible. It is unavoidable in suprapubic prostatectomy (and equally true of the majority of cases in which the perineal operation is performed) to include a portion of the prostatic urethra with the enucleated lobes. It is so firmly attached to the adenomatous enlargement that one can only with difficulty, separate the urethra from the lobes in the specimens. Fortunately epithelialization of the defect occurs rapidly so that stricture formation, etc. to which we will refer shortly is comparatively rare.



FIG. 631—View from vesical side of a stricture at the junction of the bladder and posterior end of the prostate bed (upper illustration)

b Sectional view of such a stricture showing prostatic bed and its complete separation from bladder lumen by the stricture, thus favoring stagnation and infection (Courtesy of Sir J. W. T. Walker)

HEMOSTASIS AND CLOSURE OF THE TWO-STEP WOUND Gauze packs are satisfactory for the control of bleeding after the removal of the prostate by the two-step method. The gauze packing is inserted to fit the bed snugly but not too firmly. These patients have considerable postoperative spasm from either the pack or bag. It is best to wait 48 hours before removing the packing. This should be done carefully in order to avoid hemorrhage. If removal is painful, it is best to give the patient a short nitrous oxide anesthesia. In doing the prostatectomy at the second stage there is no advantage in placing the patient in the Trendelenburg position. The prostate cannot be brought up closer except by the rectal finger and the patient is much better off lying flat on the table. In the ideal two step prostatectomy it is not necessary to suture the bladder. The bladder wound closes rapidly. If the bladder has been attached too closely to the muscle at the time of the cystotomy it should be separated. This is usually not necessary. It is however necessary to unite the fascia well for ventral hernia is a frequent complication unless this is done. A suprapubic tube is left in place for 5 days and then removed. The patient then goes about with open suprapubic drainage until the suprapubic wound closes.

POSTOPERATIVE CARE These patients get along best without any irrigations or other local treatment until after they have begun to void and the wound is

practically closed. Many patients develop a slight fever, and others a high fever with chill, when they begin to void—the so-called “closing fever” due to sudden reflux to the kidneys, or as the result of rapid systemic absorption from the infected prostatic bed.

LATE COMPLICATIONS OF PROSTATECTOMY

We are indebted to the late Sir J W Thompson Walker of London for directing our attention to some of the late complications of suprapubic prostatectomy. Similar complications may also follow enucleation by the perineal route. Urinary incontinence is one of the complications that may follow perineal prostatectomy. Even when most carefully done, incontinence of varying degree will occur in a small percentage of cases following perineal prostatectomy. The complications to which we wish especially to refer because they may be the indication for a secondary operation are shown diagrammatically in Fig 253.

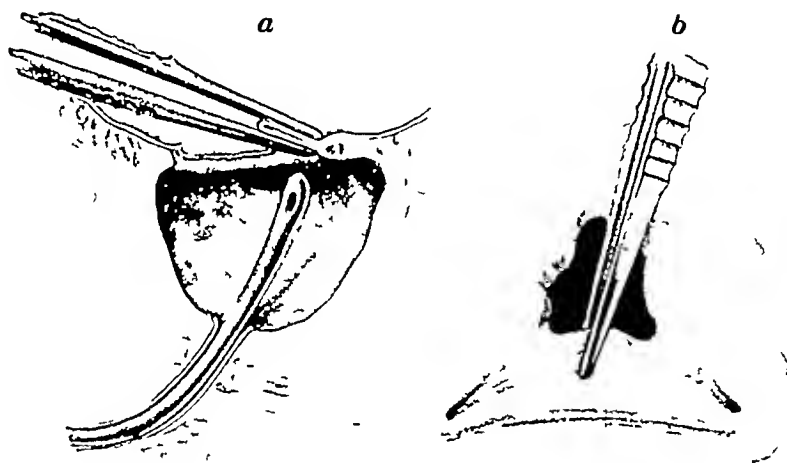


FIG 632—*a* Method of resecting the shelf (see Chap 18) between prostatic bed and floor of bladder
b The shelf is grasped by forceps (Courtesy of Sir J W T Walker)

They are

- 1 Stricture at the junction of the prostatic bed and bladder (Fig 631)
- 2 Stricture at the junction of the anterior end of the prostatic bed and urethra
- 3 A combination of both of the preceding so that an hour glass deformity results (Figs 253 and 254)
- 4 Shelf formation, i.e., there is a projecting edge from the trigone, across the roof of the cavity, from which the prostate has been enucleated

These complications are one of many causes (see Chapter 18) of unsatisfactory results after suprapubic (and possibly after perineal) prostatectomy. Walker has suggested several methods to correct such complications (if dilatation with sounds or bougies does not suffice). The “shelf” can be very readily corrected through a suprapubic incision by a wedge-shaped incision as shown in Fig 632 or by transurethral resection. The contracture at the urethrovesical junction (Fig 631) can be best corrected by transurethral resection.

OPERATIONS FOR CARCINOMA OF THE PROSTATE

We have done Young's Radical Perineal prostatectomy for carcinoma in over 25 cases. Unfortunately, it is very difficult to recognize an early carcinoma clinically for which this operation is indicated. Most of our patients already presented involvement of the seminal vesicles. The operation consists of the removal of the prostate with its capsule, the seminal vesicles and ampullae, and most of the trigone. The membranous urethra is then united to the trigone. The urologist who has had some experience in perineal surgery will find this procedure not as difficult as it appears. However, the successful end results are too few to justify this procedure, except in carefully selected cases. Permanent

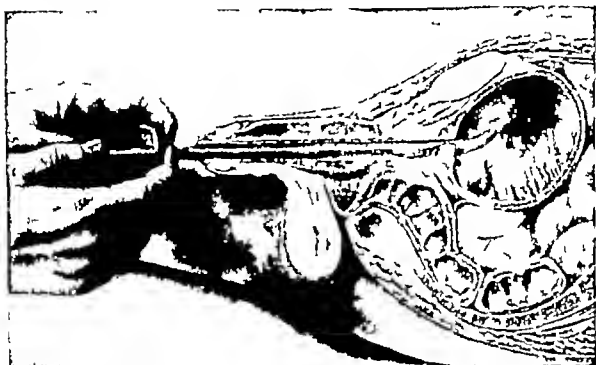


FIG. 633.—Punch operation. The instrument is drawn outward until the median bar slips into the fenestra, stopping flow of urine and preventing any further withdrawal of the instrument. The hands of the operator are shown ready to push the inner tube home. (Young's Urology W. B. Saunders Co.)

cystotomy has until recently been the operation of choice when obstruction develops. However, as stated previously in Chapter 18, transurethral resection is ideally suited for the relief of obstruction at the bladder neck due to carcinoma of the prostate.

OPERATIONS ON THE TRIGONE

In Chapter 18 attention was called to the work of Young and Wesson on hypertrophy of the trigone in cases of prostatic obstruction. They have suggested resection of the greatly thickened Interureteric ligament and adjacent portion of the trigone through a suprapubic incision. Hinman and Wesson have (1926) reported a case which was greatly helped by this procedure. Young (Practice of Urology Vol. 2 p. 369, 1926) states, however, that resection is seldom indicated because hypertrophied trigones generally atrophy when the obstruction at the

vesical neck is relieved so that the muscles of the trigone no longer are obliged to exert abnormal force to open the vesical orifice

TRANSURETHRAL RESECTION OF THE PROSTATE AND OTHER BLADDER-NECK OBSTRUCTIONS

Various attempts have been made during the past century to relieve bladder-neck obstruction by intra-urethral instrumentation. Notable among these were Guthrie in 1830, Mercier in 1841, and Bottini in 1877. The Bottini galvano-cautery was widely used and discarded because of severe hemorrhage and infection and high mortality. Young's Punch (Fig 633) in 1909 was a considerable advance over the previous instruments, for it permitted visualization, and some degree of accuracy in removing the obstruction. However, the credit for development of the present day interest in electroresection is due to Caulk, who in 1920 presented his electric cautery punch.

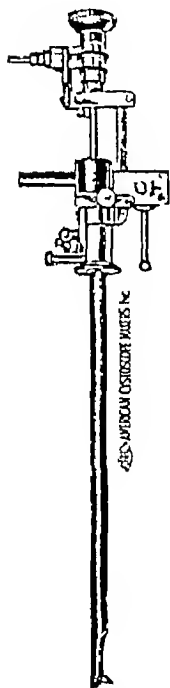


FIG 634—The Resectoscope

The instrument generally employed at the present time is the Resectoscope (Fig 634). The work of Stern and Davis in perfecting the resection loop that has been added to the McCarthy Foreoblique cysto-urethroscope, with the addition of a bakelite sheath, immediately popularized this procedure. The electric diathermy unit has a cutting current for resection, and a coagulating current for hemostasis. The spark gap current (Figs 635 and 636) is the best. The Braasch-Bumpus Thompson (Fig 637) Punch is the other type of instrument used. This is a "cold" knife; tissue is removed in somewhat the same principle as in the old Young's Punch. Bleeding is controlled whenever necessary with a Bugbee Electrode attached to a coagulating current.

Although other theories have been presented attempting to explain the mechanism of bladder-neck obstruction, clinical observations point to a purely mechanical basis as the explanation of their pathologic physiology. Thus, with the relief of obstruction by the restoration of a proper channel, symptoms are relieved. Although experience with surgical prostatectomy has shown the necessity of removing the entire hypertrophied prostate, transurethral resection apparently accomplishes the desired results in the minor degrees of hypertrophy by producing a level channel from the trigone to the verumontanum without removal of all of the hypertrophied gland. The resectoscope has permitted better visualization of the prostate and prostatic urethra than was ever possible prior to its use, so that we have a better conception of pathologic changes in the prostate.

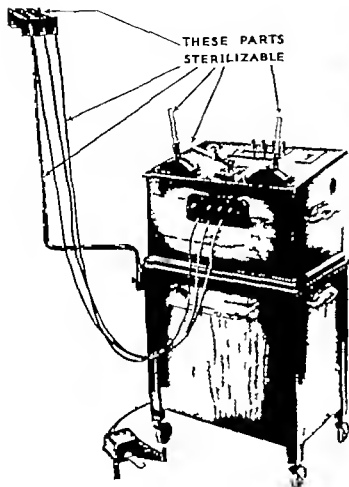
Before attempting resection, a large experience in cystoscopy is necessary. The patients must receive the same careful pre- and postoperative care as in ordinary prostatectomy. This is a major hospital procedure. In the hands of some who have had a large experience, the results have been gratifying, some reporting a mortality as low as one to three per cent.

The advantages of resection are that it avoids an open operation, and in many cases a marked reduction of the period of hospitalization, as compared with perineal or suprapubic prostatectomy.

The period of time elapsed since this procedure has come into general use is as yet not long enough to evaluate the permanency of the end results. However resection can be repeated if necessary thus permitting relief if there be recurrence of obstruction.

FIG. 635

A



B

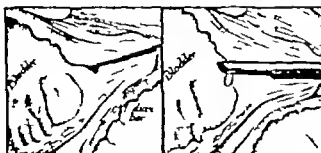
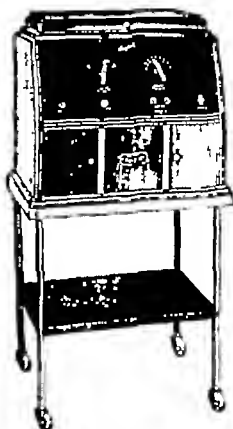


FIG. 635—A. Diathermy unit with a spark-gap mechanism for current in resection. B Shows cross-section of median bar hypertrophy C Same as B with resectoscope in place showing area that has been resected

FIG. 636



C

FIG. 636—Diathermy unit with a combination of tube and spark gap current for resection

Some urologists perform resection in multiple stages at various intervals making it a safer procedure. However the time consumed for hospitalization of patient with multiple resections is often greater than for two-stage prostatectomy.

The chief advantages of the procedure are

✓ (1) INFECTION AND HEMORRHAGE These have been discussed in chapter 18

(2) THE END RESULTS are at times unsatisfactory, the urinary frequency may persist, and the urine remains cloudy for a long time The limits of operation in resection are the trigone posteriorly, and the verumontanum anteriorly However, the hypertrophied lateral lobes may extend anteriorly in front of the veru, so that the verumontanum is sometimes situated in the middle of the hypertrophied prostate If the resection is carried in front of the veru the external

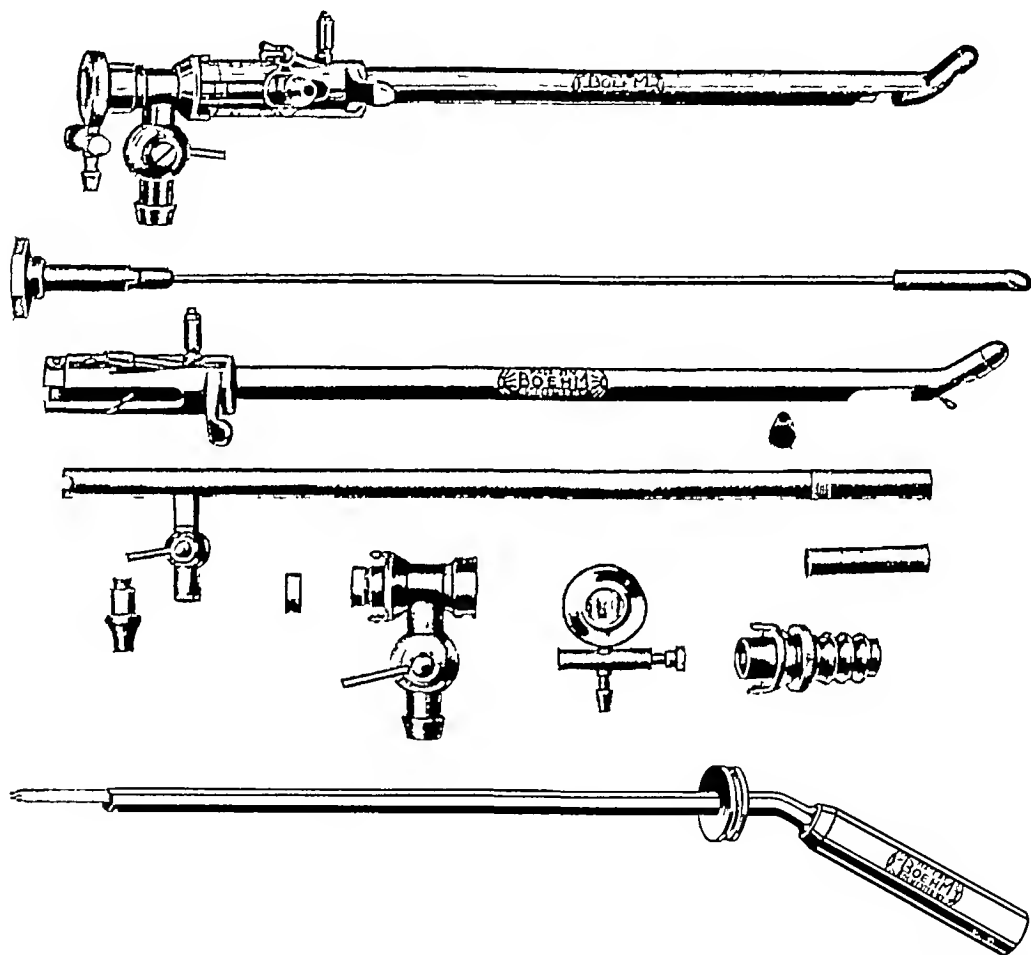


FIG 637—Thompson Direct Full Vision Resectoscope The instrument is a direct vision knife punch From above downwards Instrument ready for use, obturator, sheath, punch, coagulating electrode for those who prefer to coagulate the tissue before excision

sphincter may be destroyed, and incontinence result Although surgery carries with it the danger of shock to the debilitated patient, it is well to note that intra-urethral manipulation may produce even greater shock Until recently, many urologists felt that cystoscopy preliminary to prostatectomy was often a more formidable procedure than suprapubic cystotomy The resectoscope is usually of 28 F caliber, larger than the cystoscope, which is usually 21 F Resections should be done rapidly, prolonged instrumentation is the chief factor in shock Occasionally the markedly hypertrophied prostate will not permit the insertion of a resectoscope Urethral fever and chill may follow resection, as it frequently does following any urethral instrumentation

Technic We have been well satisfied with simple caudal anesthesia using

25 to 30 cc. of 2 per cent novocaine. We have given a general anesthetic in only a few cases. Spinal anesthesia is most frequently used. Good anesthesia for 30 to 45 minutes can be had with 50 milligrams of novocaine intraspinally. Overdistention of the bladder during the operation is more likely to occur with spinal anesthesia, and may result later in atony of the bladder which persists for a long time causing varying degrees of urinary retention. The purpose of the resection is to cut a level channel from the trigone to the veru; thus large amounts of tissue need not be removed in median bars and small middle lobes. Very frequently two median and two lateral cuts will accomplish the desired result. In median and lateral lobe hypertrophy one lobe should be resected at a time with as many cuts as are necessary before beginning with the other lobe. It is best to resect the floor of the bladder neck last. This is the point where much bleeding is likely to occur and where the operator must be most careful not to cut too deeply—undermining of the trigone and injury to the capsule with extravasation (Fig. 638) may result. One should remove as much tissue as is necessary to give a proper channel. Bleeding should be controlled at time of operation by the coagulating current. There should be a continuous flow of the irrigating medium when resection is done. Some operators make a number of cuts rapidly allowing the resected tissue to fall into the bladder and then remove these with the Elik evacuator. Not more than 45 minutes should be allowed for resection. If more tissue is to be removed this should be done as a second stage procedure. Large amounts of tissue can be removed through the resectoscope. A finger in the rectum acts as a guide to prevent cutting too deeply after much



FIG. 638.—Necropsy specimen of perforation of urethra indicated by glass rod following transurethral resection of the prostate.

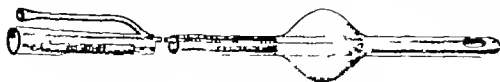


FIG. 639.—Foley hemostatic bag, hollow tip. Size 22 F.

tissue has already been removed. It also pushes the lateral lobes into view and makes them accessible to the resecting loop. A retention catheter—large caliber—is inserted after the operation. This should be irrigated frequently to prevent blocking. The Foley Alcock catheter (Fig. 639) with a hemostatic bag is particu-

larly satisfactory Traction can be employed and continuous irrigation used The catheter is removed in 2 to 3 days following operation

PROSTATOTOMY

This is usually done for drainage of a prostatic abscess and is a simple procedure The patient is placed in lithotomy position as for perineal prostatectomy and oblique incisions are made on either side of the midline A blunt curved forceps is then inserted into the space behind the transversus perinei muscles and to one side of the central tendon and carried into the prostate first on one side and then the other A finger is kept in the rectum during the entire operation as a guide The forceps breaks through the prostatic capsule and pus immediately appears if present Very often a suspected abscess proves to be merely a severe prostatitis Drains are inserted on both sides Prostatotomy is occasionally necessary for intractable chronic prostatitis that has not responded to all other forms of treatment The prostate is exposed as for perineal prostatectomy and multiple incisions are made, some tissue is also removed

OPERATIONS ON THE SEMINAL VESICLES

The various procedures for puncturing the seminal vesicles through the rectum and perineum have been mentioned in Chapter 19 The aspiration and irrigation of the vesicles or the injections of antiseptics about them, are seldom successful and are not without danger

Irrigation and medication of the seminal vesicles through the ejaculatory duct, when possible, does not accomplish all that is desired, for the fluid cannot be forced beyond the seminal vesicle into the vas deferens, except in a small percentage of cases The ampulla of the vas is always infected when the vesicle is involved and the inability to medicate it through the ejaculatory duct, minimizes the value of this procedure

Vasotomy has been discussed in Chapter 19 By means of injection of the vesicles through the scrotal vas one can medicate the entire vas, ampulla and vesicle This is the ideal procedure for direct treatment of the vesicles and very satisfactory Vasotomy should always be attempted two or three times and all other systemic and local treatments employed, before resorting to extensive surgery of the seminal vesicles

VESICULECTOMY

The only major operation that should be performed on the vesicles is their removal—vesiculectomy Vesiculotomy, incision of the vesicles and drainage of these structures, employed at times, in the past, has been discarded It is impossible to know whether all the irregular tubules of the vesicle has been incised and drainage is obtained

Technic The removal of the vesicles is done through a perineal incision (Fig 618) and with the same technic employed by Young for the removal of the prostate by the perineal route With the aid of a long tractor in the urethra, the posterior surfaces of the seminal vesicles are brought into view (A of Fig 640) An incision is made in Denonvillier's fascia (B of Fig 640), and this is

stripped from the prostate vesicles and ampulla, exposing the latter structures. The vesicles and ampulla must then be isolated and stripped away from their adhesions particularly those at the upper end (C of Fig 640). This is often difficult and must be done carefully.

After the vesicle has been freed at its upper portion a clamp can be passed between the vesicle (C of Fig 640) and the bladder and in this way more of the seminal vesicle freed. Both vesicles are completely mobilized and delivered.

They are then dissected out near the urethra and divided here. The ampullae are also clamped off and the end of the vas ligated and then the ampullae cut off.

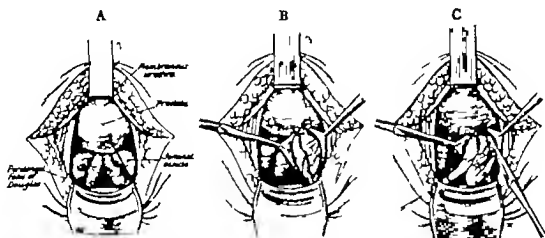


FIG. 640.—Three most important steps in seminal vesiculectomy (see text)

Vesiculectomy is a major procedure and should only be employed as a last resort.

The damage to structures of the perineum the often resulting impotency and the not infrequent failure to cure should all be considered. The ampulla of the vas should always be removed with the vesicle in order to remove a seat of infection equally as important as the vesicle.

INDICATIONS Vesiculectomy is performed to remove the chronically infected vesicle which is giving rise to local symptoms and acting as a focus of infection.

We have done Young's radical removal of the seminal tract in 10 cases. Removal of the seminal vesicles is definitely indicated when localized tuberculous abscess of the vesicles is present. Most of the 10 patients were markedly improved. It is definitely indicated in selected cases.

CHAPTER 50

OPERATIONS ON THE SCROTUM AND ITS CONTENTS

OPERATIONS ON THE VAS DEFERENS
OPERATIONS FOR HYDROCELE
OPERATION FOR VARICOCELE

ORCHIDOPEXY
OPERATIONS ON THE EPIDIDYMIS
ORCHIDECTOMY

The typical operative procedures on the scrotum and its contents include the following

- 1 Vasotomy and vasectomy
- 2 Tapping of a hydrocele
- 3 Radical operation for hydrocele
- 4 Operation for varicocele
- 5 Orchidopexy for nondescent of the testis
- 6 Epididymotomy
- 7 Epididymectomy
- 8 Orchidectomy

OPERATIONS ON THE VAS DEFERENS

Vasotomy By this is meant the injection of antiseptics through the vas deferens into the seminal vesicles for the purpose of medicating these structures

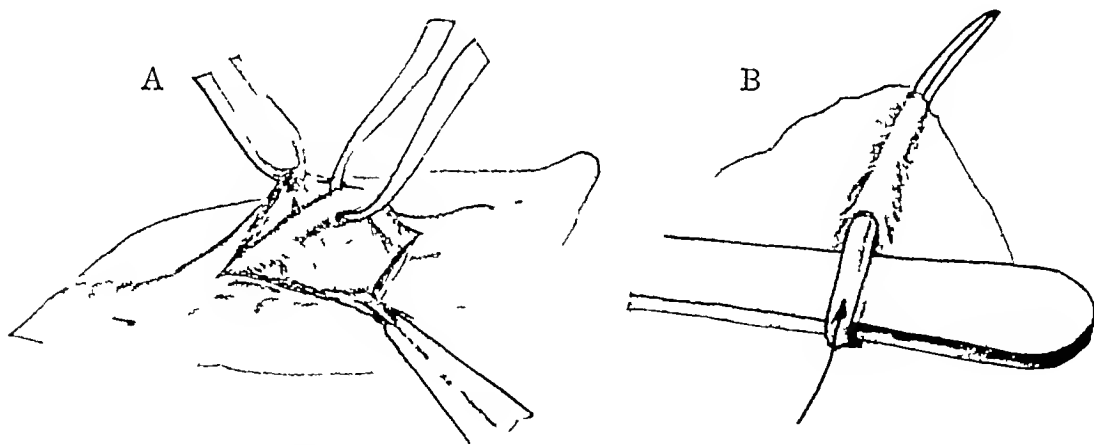


FIG 641—Vasotomy technic

A The vas is lifted above the level of a small scrotal incision three fourths inch long before being nicked with a fine sharp pointed knife, such as is used for eye operations

B The handle of an aneurysm needle is slipped under the vas, which is thus drawn tense (Courtesy of Dr W T Belfield)

It is a simple procedure and is done under local anesthesia. A 20 per cent argyrol solution has proven most satisfactory. Collargol, 5 per cent, is also satisfactory.

The iodized oils, lipoiodol and iodopin, are excellent preparations for radiography and were employed in making the radiograms of the seminal duct¹ shown elsewhere in this book. Collargol, 10 per cent, also is a good radiographic medium. The iodized oils have little therapeutic value.

¹ See Chapters 7, 9, 20 and 21

The scrotum and pubis are shaved preliminary to operation

Technic. The two important points in the operation (See Figs. 641 and 642) are (a) first to grasp the vas and fix it so that it will not slip away and (b) to be positive that the fluid is injected into the lumen of the vas.

The vas deferens is picked up in the scrotum and separated from the rest of the spermatic cord and held close to the skin of the scrotum. A 1 per cent novocain solution is then injected along the line of the vas in the skin. An incision one-eighth to one-half inch long is now made in the anesthetized area the operator having all this time held the vas up to the skin with the left hand or an assistant has done this for him. After the skin has been incised a small tenaculum forceps is now placed around the vas (A of Fig. 641) through the incision and the fingers

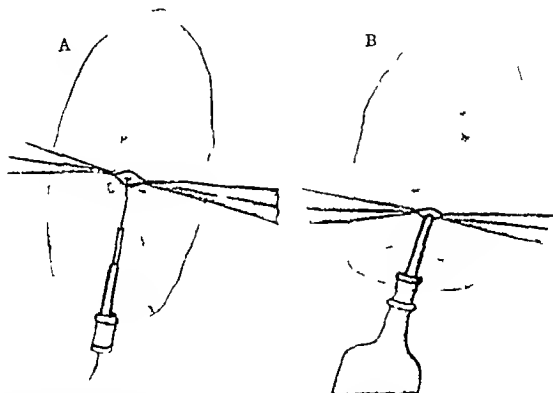


FIG. 642.—Vasotomy technic (see also Fig. 641)

A Needle being threaded over silkworm gut which has been previously inserted to test patency of lumen of the vas

B The needle has entered vas and is now attached to syringe. (Courtesy of Dr W T Bedford.)

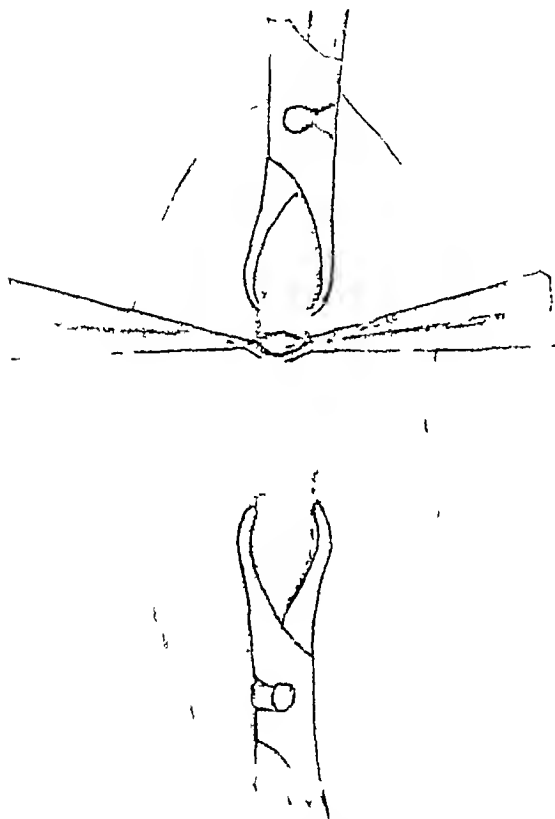
removed. The vas is thus exposed and its sheath is incised longitudinally with a fine sharp pointed cataract knife. When the vas itself is exposed it is nicked longitudinally (arrow in B of Fig. 641) with this fine bladed knife the edge of which is turned upward. The incision in the vas should only be large enough to permit a vasotomy needle to be inserted.

A silkworm thread is now inserted into the lumen of the vas through the incision (A of Fig. 642) to determine its patency. A vasotomy needle is then threaded (A of Fig. 642) over the silkworm gut and inserted into the vas deferens, after which the silkworm gut is withdrawn leaving the needle (B of Fig. 642) in place. The vasotomy needle² is blunt, and similar to a canaliculus needle.

² Such special needles with blunt tips are to be obtained through Becton Dickinson & Co.

used in eye work. Sterile water, 5 to 15 cc, is now injected through the vasotomy needle into the vas, the needle pointing through satisfactorily. This is followed by injection of 6 to 8 cc of the antiseptic on each side. This is enough to fill the vesicle. After the injection, the needle is removed. It is well to insert a silk-worm gut under the vas and through the skin and keep the vas closely apposed to the surface for the next twenty-four hours, to prevent regurgitation of the fluid. This suture should always be removed in twenty-four hours. A single skin suture is usually sufficient.

MODIFICATIONS There are various slight modifications of this procedure employed by different urologists. Vas puncture (Fig 643) consists of the injection



of the antiseptic without separating the vas from its sheath. Some have attempted injecting the vas with a sharp pointed needle, directly through the skin of the scrotum, without an incision, similar to an intravenous injection. This can but seldom, be successful.

Vasectomy This is commonly employed as a prophylactic measure preliminary to prostatectomy, for the prevention of epididymitis.

TECHNIC The vas deferens is exposed in the same manner as in vasotomy and grasped with a tenaculum forceps or small towel clip. The incision in the scrotum need not be large, for, with the vas separated from the cord, it can be pulled out for a distance of two or three inches, after it has been separated from its sheath. A tenaculum forceps is placed at the upper end of the exposed vas, and one at the lower one, and the vas ligated at the upper and lower ends, with catgut. With the vas exposed and freed of its sheath, no damage can occur to the blood vessels accompanying it or those of the spermatic cord. About one-half inch of the vas is resected and the cut ends, which have been previously ligated, are now apposed laterally, overlapping each other and ligated in order to forestall any attempt on the part of the ligated ends to reunite, as Rolnick has shown.

OPERATIONS FOR HYDROCELE

Tapping This is a frequent procedure where radical operation is contraindicated or refused. Only the smallest size trocar and canula (7F) should be employed. While the scrotal swelling is firmly grasped with the fingers of one hand, the skin over the anterior aspect of the most prominent portion of the swelling, is infiltrated and the trocar inserted through the scrotal skin and hydro-

cele sac. After the fluid has escaped the trocar is withdrawn and a small occlusive dressing applied. The scrotal puncture is so minute that sutures are superfluous.

Radical Operation for Hydrocele. Of all of the proposed procedures we prefer the following:

Nerve blocking (Fig. 165) will suffice unless there are dense adhesions between the sac and its coverings.

An incision is made large enough to permit easy delivery of the enlargement into the scrotal incision. With the fingers of one hand grasping the hydrocele adjacent testis and epididymis the intervening tissues are carefully incised until the translucent sac appears. With the aid of gauze sponges, the entire mass is freed (Fig. 644) from its bed until only the serosal covering remains. This thin

FIG. 644

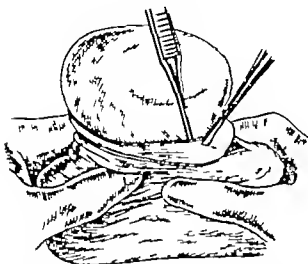


FIG. 645

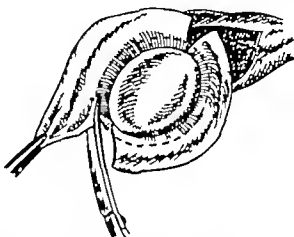


FIG. 644—First step of radical hydrocele operation. The hydrocele sac and testis are isolated from the adjacent tissues of the scrotum.

FIG. 645—Second step of radical hydrocele operation. The sac has been opened and all of the parietal layer is excised, down to the dotted line. This leaves enough to evert over hilum of testis (see Fig. 646).

sac wall is incised and after the sac has been emptied of its contents the incision into the sac is enlarged to extend from the upper to the lower pole of the testis.

While the greatly thinned tunica vaginalis is kept stretched with the aid of forceps, as much as possible of the sac wall is removed (Fig. 645) leaving only enough to permit suture of the everted edges around the hilum of the testis (Fig. 646). It is very important to remove as much as possible of that portion of the tunica vaginalis which surrounds the junction of the spermatic cord and upper pole of the testis. The majority of recurrences after the "bottle" operation have been found at this level. One should inspect the epididymis and testis carefully because so many hydroceles are of secondary origin as pointed out in Chapters 20 and 21. Very little hemorrhage is encountered in the average case but care must be exercised to ligate even the smallest bleeding point in the scrotal incision or bed of the hydrocele because a hematoma of the scrotum may attain huge proportions within the first few days after operation. If this point in the technic is overlooked. Unless the hydrocele is of inflammatory origin, we do not employ drainage but close the scrotal incision in the same manner as described under vasotomy.

Operation for Varicocele This can also be performed with the aid of nerve blocking (Fig 165) but care should be taken to infiltrate the structures of the cord, in addition to the blocking of the more superficial nerves of the skin. The higher the incision is made, the less complicated is the arrangement of the network of veins constituting the varicocele (Fig 647). We prefer an incision over the external ring (Fig 647) and begin by isolating the vas and leaving attached to it, one or two fair sized veins, in order to provide for sufficient return circulation from the testis. The veins to be resected (Fig 647) are separated by

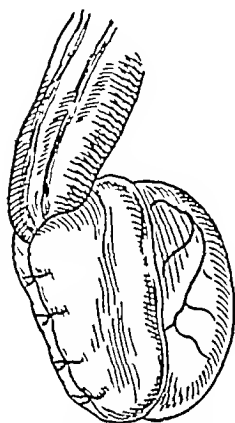


FIG 646—Third step of radical hydrocele operation

The edges of the remaining portion of the original hydrocele sac are sutured over hilum of testis, after having been everted. This permits adhesions to be formed between the visceral layer of the tunica vaginalis (and everted portion of the parietal layer) and the tissues on the inner aspect of the scrotum.

blunt dissection from the vas. Clamps are applied about 2.5 to 5 cm (one to two inches) apart, to the veins to be resected, and the segment between the two clamps, removed. The proximal and distal stumps should be doubly ligated (Fig 647), preferably with chromic catgut which is not of too large a size, because of the tendency of the latter to act as a foreign body. One should not depend upon ordinary en masse ligation, but transfix the vein ends, because quite serious postoperative bleeding may follow imperfectly tied ligatures. The proximal and distal ligated stumps are brought into apposition (Fig 647) by ligatures. Some operators prefer amputation of the scrotum as a substitute or an adjuvant procedure. We have discarded the operation for the reason that the scrotum attains its former length within a comparatively short period, thus nullifying the purpose of the amputation. The latter is also much more difficult than a varicocele operation and the bleeding, much more of a factor.

ORCHIDOPEXY

This operation is indicated

- a In cases of arrested descent (see Chapter 21)
- b In cases of faulty or aberrant descent (see Chapter 21)

Arrested Descent We will first describe orchidopexy in cases of arrested descent. The technic may be divided into First Mobilization and Second, Fixation of the testis.

First—Mobilization of the Testis

The objective is to bring the testis down to the level of the lowermost portion of the scrotum. We have found the technic as described by Dr A. D. Bevan to be the most satisfactory method of mobilizing the testis. The steps of the mobilization are as follows:

STEP 1 Incision as for inguinal herniotomy (A of Fig 648). The aponeurosis of the external oblique is divided from the level of the internal inguinal ring (a little above the middle of Poupart's ligament) to that of the external ring. The anterior wall of the inguinal wall having been thus divided, the testis is usually found (B of Fig 648) lying on the posterior wall of the canal or just beyond the external ring at the uppermost portion of the scrotum. In some cases, the testis lies within the abdominal cavity and must be pulled out through the internal ring into the opened inguinal canal. The testis is isolated and the

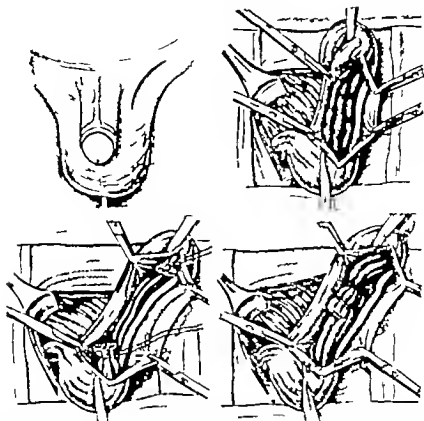


FIG. 647.—Operation for varicocele shown in successive steps. The incision is made as high as possible preferably over inguinal canal. The varicosities of the veins of the pampiniform plexus are now exposed. Veins next isolated from vas deferens leaving one or two small veins for return of blood. Veins doubly ligated and segment about $1\frac{1}{2}$ inches resected. Ligated ends placed side by side.

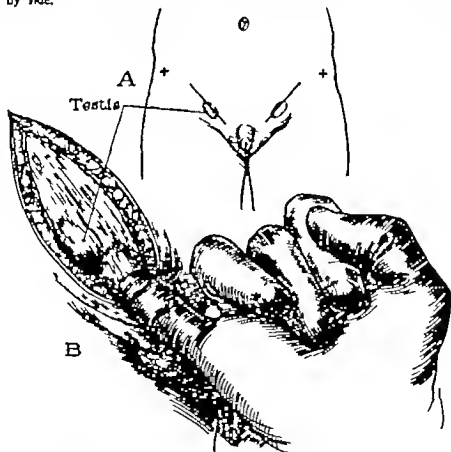


FIG. 648.—A. Most frequent location of testes either within inguinal canal or just beyond external ring. B. Poorly developed intercolumnar fibers allowing little finger to be inserted through external ring for quite a distance.

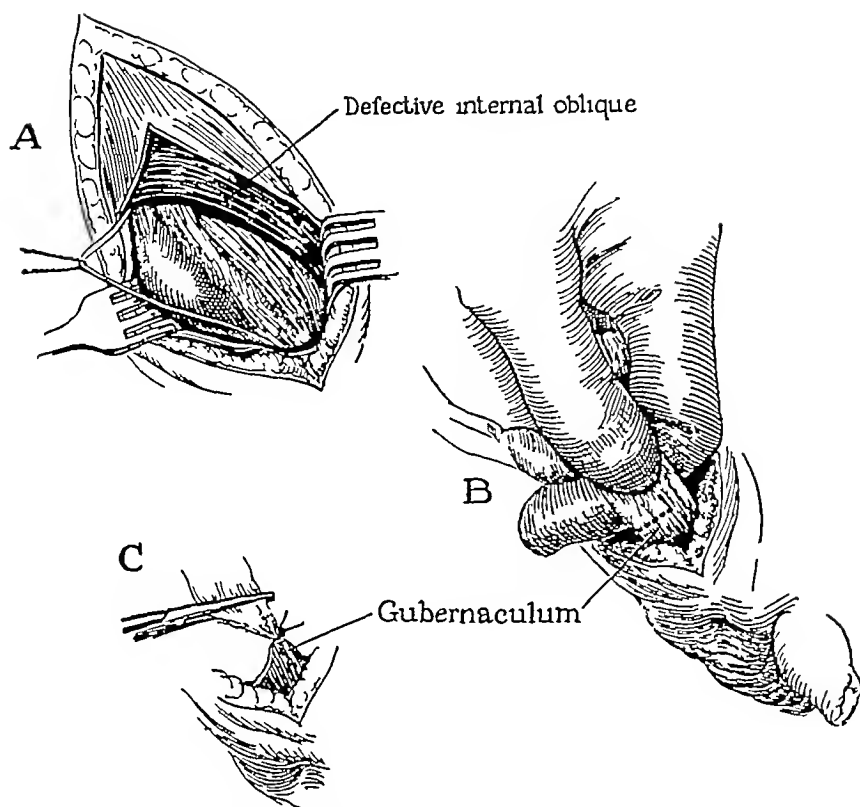


FIG 649—A Inguinal canal opened, showing congenital deficiency in development of conjoined tendon and arching fibers of the internal oblique Ilio-inguinal nerve held aside B Gubernaculum held between index finger and thumb, before being divided at dotted line Distal portion should be ligated (C) because it often contains a small vessel Note point of attachment of gubernaculum when scrotum is retracted

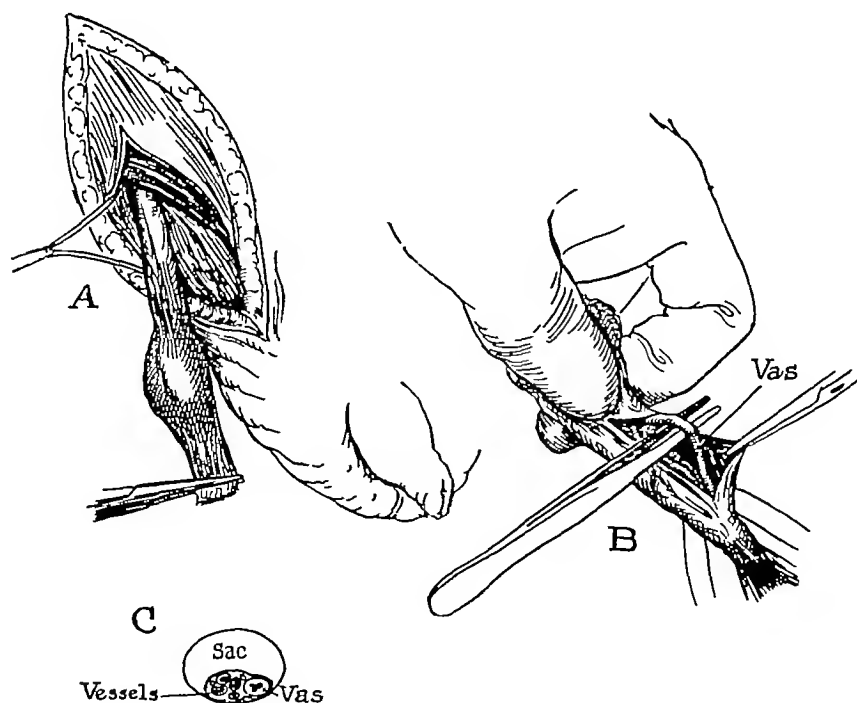


FIG 650—A After division of the gubernaculum (see Fig 309) the distance which testes can be brought down is estimated for first time B Separation of vas and veins from outer aspect of sac They lie in compartments as seen in C, in outer wall of sac, and can be easily overlooked unless sac is put on the stretch as shown in A Very fine instruments should be employed

gubernaculum divided while kept stretched (Fig. 649). A small vein in the distal portion of the gubernaculum may require ligation.

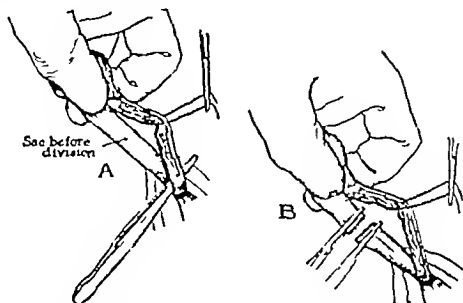


FIG. 651.—A. The va and vessel have been isolated and held aside with a loop of catgut or silk.

B. The sac is divided into a proximal and distal portion as far as possible from the internal ring.

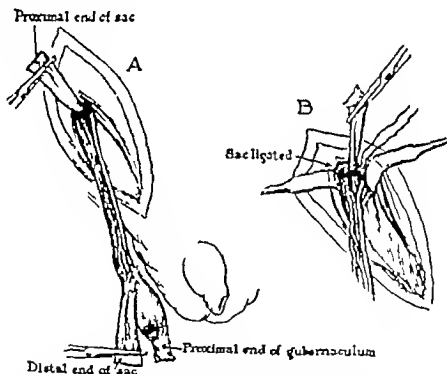


FIG. 652.—A. Before the proximal portion of the sac has been ligated the testis is brought down beyond lower end of scrotum in order to determine whether any further mobilization of the vas or its vessels, or both, is necessary.

B. The sac is ligated high up after one is sure that the testis can easily be brought to bottom of scrotum. Too early ligation of proximal portion of sac interferes with high separation and mobilization of the vessels and vas from the outer aspect of the peritoneum.

STEP 2 The vas deferens and spermatic vessels lie in a sheath (B of Fig. 650) and in most intimate relation to the outer surface of the obliterated vaginal process or to the frequently associated hernial sac, which represents the

nonobliterated vaginal process The vas deferens is first identified as a fine white cord, then most carefully separated and held aside temporarily with a loop of catgut The vessels are next isolated, preferably with the aid of a fine blunt-pointed tissue forceps, and included in a loop of catgut holding the vas deferens (A of Fig 651)

STEP 3 The hernial sac is next divided into a proximal and distal portion (B of Fig 651), as far away from the internal ring as possible We have modified the Bevan technic by everting the distal portion of the sac around the testis to prevent formation of a hydrocele (B of Fig 654)

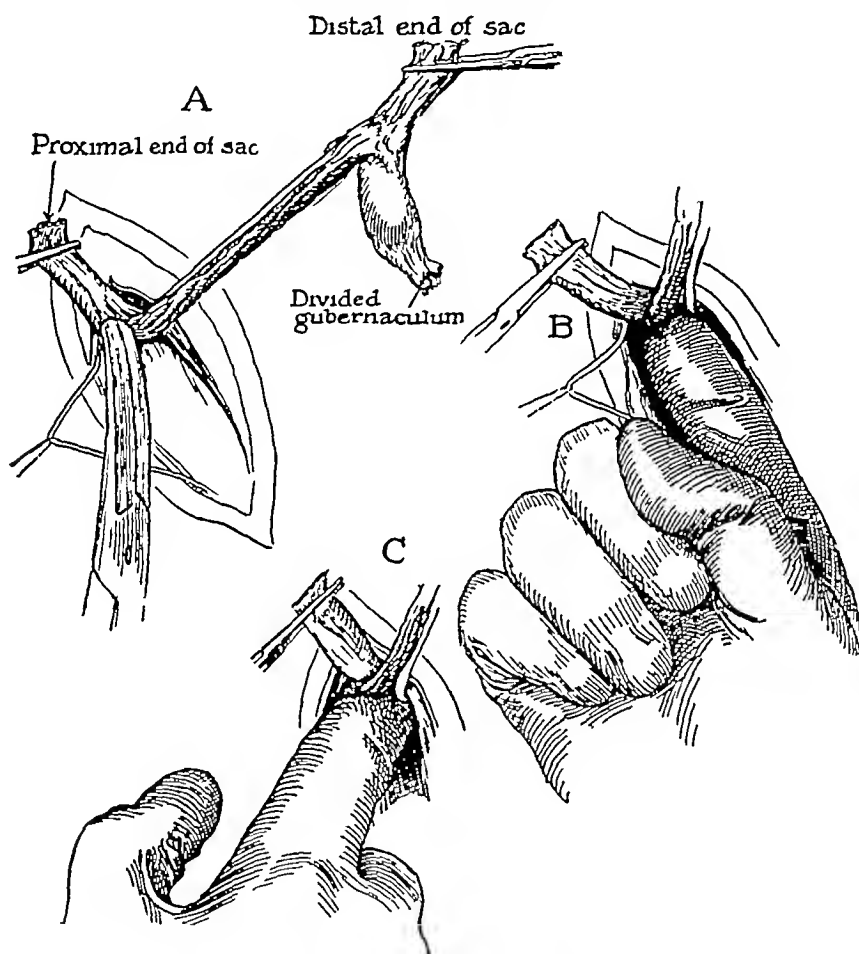


FIG 653—A Traction upon non-ligated proximal portion of sac while vessels are separated from sac and structures of iliac fossa with aid of blunt pointed curved scissors

B Same manipulation, using index finger instead of scissors

C The same technic as shown in A and B is employed in the direction of the bladder in order to mobilize the vas as it passes down and inward toward floor of true pelvis

STEP 4 While traction is made with the aid of a small artery forceps applied to the proximal portion of the sac (Figs 652 and 653), the vas and vessels are mobilized (B of Fig 651) by dividing all bands of tissue which prevent the testis from being brought down to the lower portion of the scrotum We have found that by using a fine curved blunt-pointed scissors and the fingers (Fig 653) all fibrous tissue holding the vas and vessels can be easily separated without injuring them The advantage of ligating the proximal portion of the sac after the vas and vessels have been completely freed from adhesions, is that the vessels and vas can be separated much higher than by ligating the sac immediately

FIXATION OF THE TESTIS This constitutes the second part of the operation. Its objective is to prevent retraction of the testis whose vessels and vas have been sufficiently mobilized to enable the testis to be easily brought down to the lowermost portion of the scrotum. In over 500 orchidopexies Dr. Bevan has never found it necessary to employ any method of fixation of the testis if a purse-string catgut suture is placed just beyond the external ring after closure of the inguinal canal. The end results of others who have employed this technic have not been as satisfactory, retraction having taken place in about half of the cases. For this reason efforts have been made to prevent such re-

FIG. 654

FIG. 655

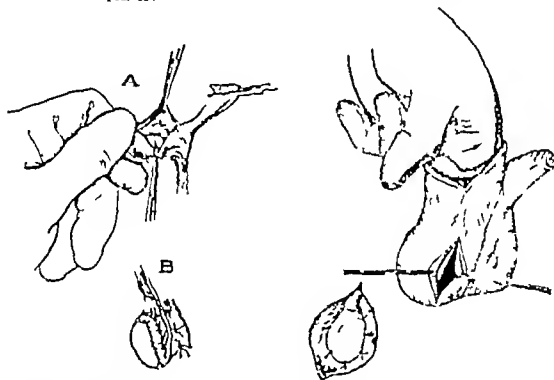


FIG. 654—A The distal portion of the scrotum is opened and everted around testis as in the radical operation for hydrocele.

B The everted edges are united at hilum of testis.

FIG. 655—Final step of orchidopexy for nondescent of testis. The fingers of the hand of operator create a bed at lowermost portion of scrotum for testis to rest in. An incision is made through skin of scrotum with fingers spread apart as a guide.

The insert shows how the testis is anchored with fine chromic gut sutures to inner aspect of lowest portion of scrotum before skin of latter is closed separately.

traction. One of us has described a method by which a separate opening is made at the lowermost portion of the scrotum (Fig. 655) and the testis sutured to the dartos scroti with fine (00) chromic catgut.

THE TECHNIC DESCRIBED BY F. TOREK (*N. Y. Med. J.* 1909 90 948 and *Ann. Surg.* 1931 94 97) to prevent retraction of the testis is being extensively used. An incision (after mobilization of the testis as described above) is made in the lower lateral portion of the scrotum and another is made in the adjacent thigh (A of Fig. 656) down to the fascia lata. After suture of the posterior skin margins of the thigh incision with chromic catgut the testis is brought (B of Fig. 656) through the scrotal incision and anchored (A of Fig. 657) by several fine chromic catgut sutures to the fascia lata. The anterior margins (A of Fig. 658) of the scrotal and thigh incisions are now united over the testis. A vas-

eline wick (B of Fig 658) is drawn through the tunnel in the angle between the scrotum and thigh. A dry dressing is applied and the knees are bound together for the ten or twelve days the boy is kept in bed. Three months or

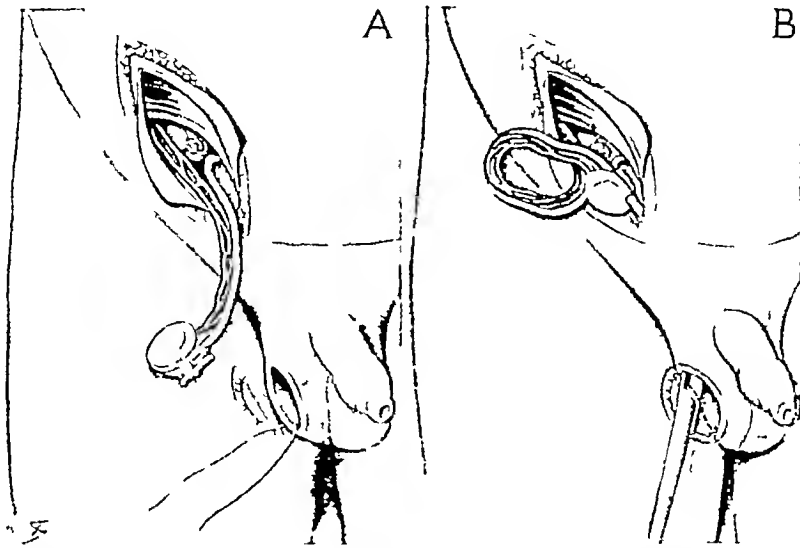


FIG 656—Technic of Tork operation for undescended testis (see also Figs 657 and 658). A Placing of testis on thigh to prove sufficient length of vessel. Mode of suturing posterior lip of thigh and scrotal incision is shown. It is completed in B. In this latter drawing, the testis is being pulled down through the scrotal incision before being placed in its new bed on the fascia lata of the thigh.

later, the testicle is separated from the thigh and replaced in the scrotum, followed by closure of the thigh and scrotal incisions. If the cryptorchidism is bilateral, the operation is commonly done in three stages, the second testis

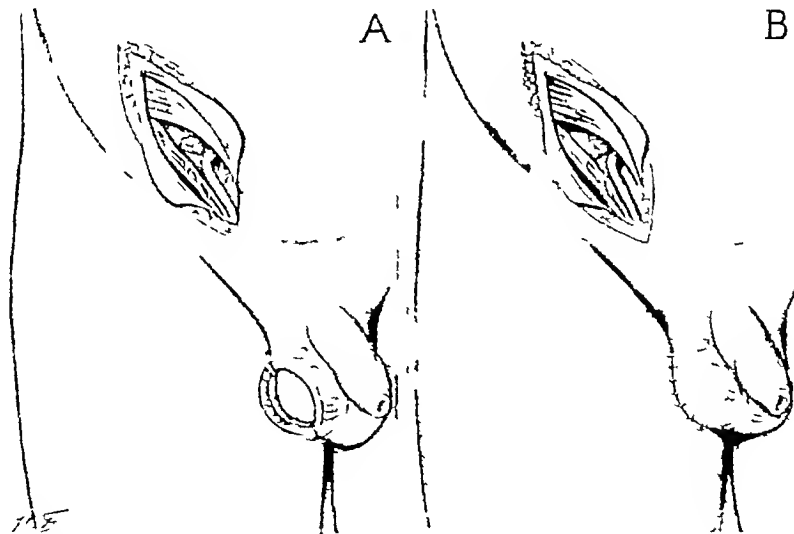


FIG 657—Technic of Tork operation for undescended testis (see also Figs 656 and 658). A The testis is anchored to the fascia lata by several sutures. B Closure of the anterior lips of the scrotal and thigh incisions.

being anchored to the thigh at the time the first testis is liberated from its bed and replaced in the scrotum.

CLOSURE OF THE INGUINAL INCISION constitutes the final step of orchidopexy. We have found that as a rule there is a marked deficiency in the development

of the arching fibers of the internal oblique muscle (Fig 649) and of the conjoined tendon of the internal oblique and transversalis muscles. For this reason the Andrews modification of the Bassini herniotomy technic is to be recommended because the posterior wall of the canal instead of being formed by the conjoined tendon and internal oblique muscle alone is reinforced by the fibers of the external oblique aponeurosis from the mesial flap of the original incision made to open the inguinal canal.

We do not transplant the vas and its vessels which emerge through the external instead of the internal ring. Thus the outer flap of the external oblique aponeurosis is brought over to reinforce the new formed anterior wall of the canal the posterior wall when the cord is not transplanted being formed by the subperitoneal tissues and transversalis fascia.

Second—ORCHIDOPEXY IN CASES OF FAULTY OR ABERRANT DESCENT (Fig 283A)

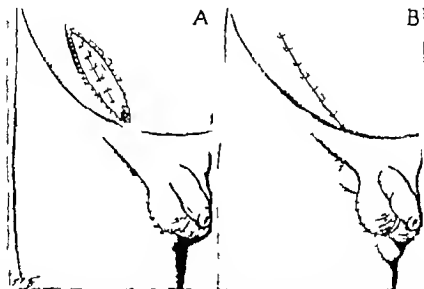


FIG 655.—Technic of Tork operation for undescended testis (see also Figs 656 and 657). A. Closure of inguinal canal with or without transplantation of the spermatic cord. B. A rubber dam or gauze drain is shown introduced through both extremities of the scrotal thigh incisions which have been sutured. No attempt should be made to replace the testis in the scrotum until two months after the primary operation.

The first step consists in freeing the adhesions which retain the testis in its abnormal position (a) over the pubes (b) over Scarpa's triangle or (c) in the perineal region. The next step is to open the inguinal canal and separate the vas and vessels from the open vaginal process which usually is present following the technic described under arrested descent cases. Replacement of the testis in the lowermost portion of the scrotum does not present as much difficulty as in arrested descent cases hence the various methods of fixation previously described are seldom if ever indicated.

OPERATIONS ON THE EPIDIDYMIS

Epididymotomy The purpose of the operation is to relieve the pain and other symptoms of the epididymitis and hasten the cure. Although the results of epididymotomy have been excellent, its use has been limited in the last few

years to those cases of epididymitis that do not resolve within 2 to 3 weeks, and also to those cases in which there is definite evidence of abscess formation

Epididymotomy should consist of a single sharp incision into the tail of the epididymis, if the operation is performed within the first few days. If performed later, a clean-cut incision, freeing the tunica, and incising the abscesses in the body as well as the tail, are necessary. Careful nicking of the abscesses

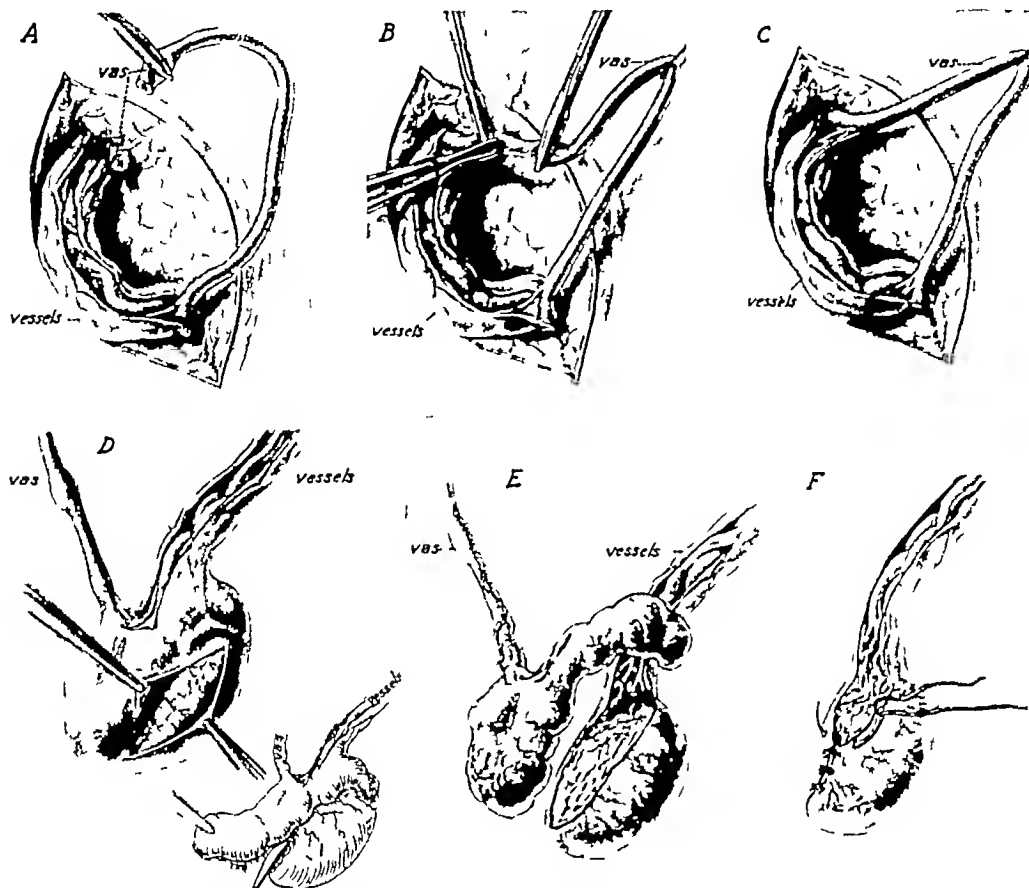


FIG 659—Steps of epididymectomy

- A Divided vas grasped and separation from vessels continued to hilum of testis
- B Division of vas deferens with cautery
- C Isolation of vas from vessels of cord close to internal ring
- D Tunica vaginalis opened so as to begin separation of epididymis without injury to vessels entering the hilum of testes
- E Epididymis and vas completely separated from testis and vessels
- F Closure of hilum of testis by union of edges of tunica vaginalis

and incision of the dilated tubules is necessary, because the purpose of the operation is the relief of tension and the promotion of drainage. A gutta-percha drain is left in place twenty-four hours, and the skin wound closed.

Epididymectomy. As was explained under tuberculosis of the male genitalia (Chapters 20 and 21), every effort should be made to conserve the testis on account of its internal secretion. Unless the tuberculous process has invaded the testis, epididymectomy is the operation of choice. The steps of the technic³ are as follows:

STEP 1 INCISION. This is of sufficient length to permit high ligation of the vas, i.e., as near the external ring as possible (C of Fig 659). It then extends

³ See article by one of us in Jour of Urol, 1920, 4, 363 (August)

along the anterior aspect of the scrotum far enough so that the testis and epididymis can be easily delivered into the wound.

Step 2 The vas is fully isolated, doubly ligated (B of Fig 659) and divided with the electric cautery (B of Fig 659). The distal end is now followed down to the point where it passes over into the epididymis. The chief advantage of first isolating the vas from the vessels of the cord beginning at the external ring and dividing it here, is that it is far easier to follow the vessels to the point where they enter the hilum of the testis and thus preserve their integrity, than if the epididymis were mobilized first.

Step 3 The tunica vaginalis is now opened (D of Fig 659), and the separation of the tail of the epididymis from its attachment to the testis begun by sharp dissection (D of Fig 659). This is continued until the body and head of the epididymis have also been separated (E of Fig 659). It will be found that the preliminary ligation and mobilization of the vas (A, B and C of Fig 659) greatly facilitate the separation of the epididymis, because they enable one to constantly see the vessels entering the hilum of the testis.

Step 4 After removal of the epididymis and vas (E of Fig 659) the parietal layer of the tunica vaginalis is resected its edges everted and sutured over the hilum of the testis (F of Fig 659).

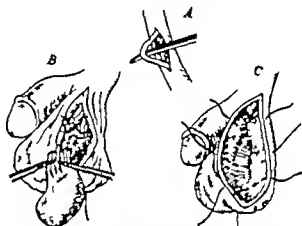


FIG. 660.—Steps of castration.

A Vas isolated and separately ligated.

B Vessels and vas are seen to be ligated. Testis with epididymis at lower end of scrotum ready to be removed.

C Closure of bed in two rows: one for dartos scroti (of catgut) and one for skin (of fine waxed silk).

ORCHIDECTOMY

Although the epididymis and scrotal portion of the vas deferens are removed at the same time as the orchis or body of the testis i.e. an orchidovaso-epididymectomy is performed the operation is usually referred to as orchidectomy. The indications were given in Chapters 20 and 21 and will not be repeated here. We only wish to again emphasize the fact that in our opinion not enough is to be gained in neoplasms of the testis to justify such an extensive removal of the regional lymph nodes as proposed by Chevassu and Hinman. For this reason the description of such a radical operation will be omitted here.

Operation. Orchidectomy can be performed in most cases under regional (block) anesthesia. It is well to have the patient awake so that he can be informed that the testicle must be removed when that becomes necessary. It often happens that a tumor of the testis is only discovered after the testicle is brought into view. The incision should extend from the external abdominal (inguinal) ring to the lower pole of the tumor. Separation should begin at the latter point care being taken to excise any sinuses (in suppurative cases) en masse with the main portion of the enlargement. Having freed the latter and ligated all bleeding points on the inner aspect of the scrotum the mass is lifted up so that the

structures of the spermatic cord can be separately ligated (A and B of Fig 660) The vas is first ligated and divided

In orchidectomy for neoplasms or tuberculosis we often divide the vas with the electric cautery (B of Fig 659) The vessels accompanying the vas, are next doubly ligated (with chromic catgut), and also divided high up The scrotal incision is closed in layers (C of Fig 660) with ample provision for drainage, preferably through and through, i e, through the lower and upper ends of the incision

CHAPTER 51

OPERATIONS FOR STERILITY IN THE MALE

STRICTURES

EJACULATORY DUCTS
VAS DEFERENS

TREATMENT

VASO-EPIDIDYMOSTOMY
UNION OF VAS DEFERENS TO SPERMATOCELE
UNION OF VAS DEFERENS TO THE RETE TESTIS

The operations for sterility in the male are performed to relieve obstructions either in the epididymis or vas deferens and rarely in the ejaculatory duct.

Bilateral epididymitis is the most frequent cause of obstructive sterility in the male and in the vast majority of cases the result of gonorrheal infection. Strictures of the vas deferens which are frequently associated with an epididymitis and sometimes occur alone are not infrequent causes of obstruction of the seminal duct. Stricture of the ejaculatory duct is also an etiologic factor but is only rarely found.

Various procedures have been recommended and employed for restoring the continuity of the obstructed seminal duct. Practically all consist in short circuiting the vas deferens for a block in the tail of the epididymis and the resection and reunion of the strictured vas deferens, for obstruction of this duct.

Successful end results have however been so few that the patient can entertain very little hope for renewed fertility. The Martin operation of vaso-epididymostomy¹ and its various modifications—a procedure most frequently employed—has with few exceptions² given no more than 10 per cent successful results.

Because of the large number of failures, some men have abandoned all attempts toward restoring the continuity of the duct and recommend puncture of the testicle or epididymis aspiration and artificial impregnation.³ Lescage's artificial spermatocele sac⁴ was for the purpose of accumulating a large quantity of semen, to be deposited in the same manner.

STRICTURES

EJACULATORY DUCTS

Permanent Occlusion of the Ejaculatory Duct Is Rare. Temporary blocking due to plugs of mucus or pus or edema and distortion of the verumontanum is quite common. When stricture is found dilatation through the endoscope⁵ may be possible. Most attempts at dilatation are unsuccessful.

VAS DEFERENS

Strictures of the Pelvic Portion. These are fortunately quite rare having been found in about 1 per cent of vasotomies.⁶ Repair of these strictures

(a) Pennsylvania Medical Bulletin March 1902 p 388 (b) N Y Med. Jour 1903 78, 697 98

Hagner Young's Urology W. B. Saunders Company Phila., Pa 1926 Vol. 2 543

Posner Zeitschrift für Urologie, 1924 18, 132 33 Discussion.

Jour A. M. A., November 29 1914 63 1916-1918.

Young's Urology W. B. Saunders Co 1926 Vol. 1 275

Belfield, W. T. Personal Communication.

is practically impossible because of their inaccessible location Boari⁷ united the vas to the anterior urethra and recommended this method for the relief of strictures of the pelvic vas and ejaculatory ducts

Strictures of the Scrotal Portion These include all strictures of the vas up to the external inguinal ring and for a few inches beyond, because the redundancy of the vas deferens allows it to be pulled out for some distance. Strictures of this portion of the vas deferens are quite common

They are frequently present in association with an epididymitis and must be removed before any attempt is made at short circuit of the vas. They are also frequently found without a previous epididymitis—these are usually bilateral—and analogous to bilateral strictures of the lower portion of the ureter. They may also be due to trauma or injection of strong irritants in vasotomies.

The scrotal vas is an accessible portion of the vas deferens and strictures in this region can be readily and successfully repaired, in the majority of cases. Resection of the strictured portion and end-to-end anastomosis, with a silk worm in the lumen, coming out through the skin, to act as a splint and as an aid to direct epithelialization, has proved successful in many cases. Successful results with this and other procedures, both clinical and experimental, in restoring the patency of the vas have been reported by Mayo,⁸ Lydston,⁹ Christian and Sanderson,¹⁰ Pignatti,¹¹ Wheeler,¹² Schmerz,¹³ Seyberth,¹⁴ Gohrbandt,¹⁵ and others.

TREATMENT

VASO-EPIDIDYMOSTOMY

Vaso-epididymostomy—union of the vas deferens to the epididymis above the obstruction, and vaso-orchidostomy,—union of the vas to the rete testis, are the procedures employed for the relief of the occluded epididymis.

Martin's original operation was a lateral anastomosis of the vas to the head of the epididymis with catgut sutures, the operation being entirely extravaginal. Since then, various modifications in the suture material used and in the choice of the point of attachment to the epididymis have been reported by Fuller,¹⁶ Hagner,¹⁷ Quinby,¹⁸ and others.

Silk, human hair, and silver wire for suture material, and the placing of the sutures to produce a circular anastomotic channel, are some of the variations from the original. Anastomosis of the vas to the epididymis¹⁹ and union of the vas of one side to the epididymis of the other side,²⁰ have been reported

⁷ *Semaine Medicale*, Paris, 1909, 29, 445-46

⁸ *Annals of Surgery*, Jan., 1895, 21, 35-37

⁹ *Jour. A. M. A.*, July 21, 1906, 47, 160

¹⁰ *Jour. A. M. A.*, 1913, 61, 2157

¹¹ *Zentralblatt für Chirurgie*, 1914, 41, 27, 1174—abstract

¹² *Brit. Med. Jour.*, 1914, I, 302

¹³ *Bruns' Beiträge*, 1923, 129, 342-347

¹⁴ *Zentralblatt für Chirurgie*, 1923, 50, 27, 1062

¹⁵ *Zeitschrift für Urologie*, April, 1926, 20, 4, 247-249

¹⁶ *Medical Record*, N. Y., 1907, 229

¹⁷ *Jour. Urology*, 1925, 13, 377-382

¹⁸ *Boston Med. and Surg. Jour.*, 1906, 155, 539-541

¹⁹ *Hagner Trans. Amer. Asso. of G. U. Surg.*, 1913, 8, 142

²⁰ *Hagner Surg., Gyne. Obst.*, 1914, 19, 792

Bogoljuboff²¹ reported a series of experiments in which he resected the tail of the epididymis and implanted or united the cut end of the vas to the epididymis with a few successful results

The reasons for the relatively few successes in vaso-epididymostomy may be summarized thus

1 VASO-EPIDIDYMOSTOMY IS NOT A DIRECT ANASTOMOSIS A cup-shaped piece of tubule of epididymis is removed in the hope that anastomosis will develop from one of the convolutions. Direct vaso-epididymostomy²² is rarely possible because of the almost microscopic size of the tubule of the epididymis above the tail.

2 SLIGHT HEMORRHAGE WITH A BLOOD CLOT AT THE POINT OF ANASTOMOSIS TRAUMA OF THE OPERATION AND THE IRRITATION BY THE SUTURE MATERIAL, CAN PRODUCE ENOUGH SCAR TISSUE TO OCCLUDE THE ANASTOMOTIC CHANNEL. McKenna²³ recommended a procedure which he modified later,²⁴ for the purpose of preventing clots from organizing and closing the point of anastomosis as shown in (A of Fig 661) and reported some success It consists in the inser

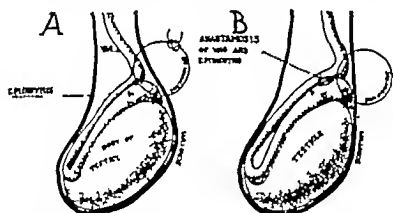


FIG 661.—A. McKenna operation. Lateral anastomosis of vas to epididymis. Silkworm gut passes through anastomotic opening and is tied over scrotal skin.

B Same as A but silkworm gut passes through epididymis above point of anastomosis to prevent movement of vas and also to relieve tension on line of anastomosis. Method used by Rohnick (see page 828)

tion of a silkworm-gut as a retention suture through the vas through the point of anastomosis, and through the epididymis, then united on the skin of the scrotum and left in place five to seven or ten days

3 THE EPIDIDYMIS TUBULE IS VERY THIN AND AS FRIABLE AS TISSUE PAPER Any suture material will tear through readily and particularly so as the result of the edema following the trauma of the operation. Even though the point of anastomosis be in the intravaginal portion of the epididymis union will not be very firm for the tunica vaginalis covering the epididymis is much thinner than that covering the testicle²⁵

4 THE TESTICLE MOVES UP AND DOWN WITH THE CONTRACTION AND RELAXATION OF CREMASTER FASCIA AND DARTOS and the vas deferens which is redundant and also has some elasticity and peristaltic action tightens takes up slack and

²¹ Archiv für Klinische Chirurgie, 1903 70 848-56

²² Lescage. Jour A M A., Feb 16 1918 70 443-450.

²³ Jour A. M. A., June 26 1915 64 2127-29

²⁴ Surgical Clinics of Chicago, Feb 1919 3 1 145

²⁵ Morris. Human Anatomy 5th Ed., 1914 1256

again becomes elongated with the movements of the testicle, and with filling and emptying of the bladder. Because of these factors, there is always considerable tension at the point of anastomosis, with a resulting separation of the apposed tubules. This is probably the most important cause for failure of the operation.

One of us has recently had a successful result in which an attempt was made to limit the mobility of the testicle and vas, as shown in (B of Fig 661). A silkworm-gut was introduced through the vas and epididymis, as in the procedure recommended by McKenna, except that the silkworm emerged from the vas above the point of anastomosis, then it passed through the epididymis above the point of anastomosis, and out through the skin.

5 OCCLUSION OF ANASTOMOTIC CHANNEL It may be well to note that when a successful result is obtained with any of the procedures mentioned, or any of the others to be discussed, that the new anastomotic channel may become gradually occluded by contraction of scar tissue around it or within its lumen, so that one cannot speak of permanent results.

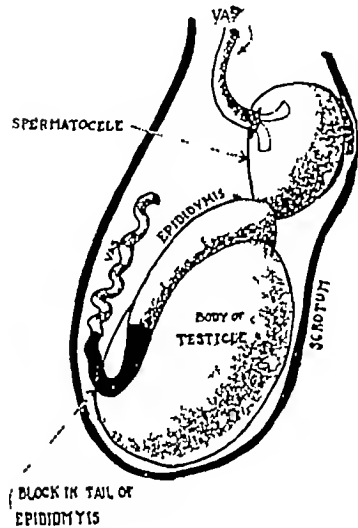


FIG 662—Vas implanted into a spermatocele (if latter is present). This operation offers much chance for success.

UNION OF VAS DEFERENS TO SPERMATOCELE

Spermatoceles are common and may be present coincidentally with occlusion of the epididymis. Lateral anastomosis or implantation of the cut end of the vas into the sac, as shown in Fig 662, offers excellent possibilities for success. Hagner²⁶ has reported a successful case. Attempts to produce a true spermatocele experimentally, for the purpose of having a sac to which the vas could be attached, have been unsuccessful.²⁷

UNION OF THE VAS DEFERENS TO THE RETE TESTIS

The rete testis is an intercommunicating network of tubules located in the mediastinum of the testicle, whose function is similar to that of the renal pelvis, the sperm accumulating in the rete and passing out into the efferent ducts. The vasa efferentia and the rest of the seminal duct are developed from the wolffian body and wolffian duct, whereas the rete develops from the genital gland.²⁸ In some lower vertebrates, living in water, and in many invertebrates, the duct system does not exist, the sperm is expelled from the rete into the peritoneal cavity, as is the ovum of the human female, and then out through openings in the lower abdomen.

The testicle has a thick tunica vaginalis and also a tunica albuginea and vasculosa, so that sutures inserted through its coverings have an excellent chance of remaining in place. The rete testis, consisting of many tubules, should, theoretically at least, offer better opportunities for anastomosis than the single tubule of the epididymis.

²⁶ Young's Urology, W. B. Saunders Co., 1926, 2, 543.

²⁷ Rolnick, H. C. (See Reference 30).

²⁸ Wilson. Contributions to Embryology, 1926, 27, No. 85-89.

Union of the vas to the rete was first done experimentally by Scaduto²⁰ who resected the epididymis and united the cut end of the vas to the rete. None of his operations were successful. Bogoljuboff²¹ reported a few successes and since then various authors mostly foreign have reported varying degrees of success and failure with this procedure.

PROPHYLAXIS IN EPIDIDYMITIS

In acute and chronic infections of the seminal vesicles the spermatozoa are often dead. They are killed on their way through the vesicles by the bacteria and pus. Vasotomy has cured many cases of sterility due to infections of the seminal vesicles by sterilizing these structures.

Recent experimental work by one of us²² has demonstrated that the infection in acute epididymitis is at first in the interstitial and peritubular tissues and not intratubular. The occlusion as the result of epididymitis is due to the compression and later destruction of the tubule as the result of external pressure with formation of scar tissue. The indications for treatment are to relieve the tension on the tubule and promote drainage. Epididymotomy consisting of one free incision in the tail of the epididymis only the operation being entirely extravaginal will accomplish this purpose.

Early epididymotomy performed as above stated will help to reduce the incidence of permanent occlusion of the epididymis following epididymitis. A clean incision of the tubule will do very little damage for the regenerative capacity of the uninfected tubule is very marked and the relief of tension will allow early restitution to normal.

²⁰ *Annales des Maladies des Organes Génito-Urinaires* 1901 19 237 293

²¹ *Ročník. Pathology of Epididymitis, Surg. Gynec. and Obst.* 45 557 Oct. 19 7

CHAPTER 52

OPERATIONS ON THE BLADDER

OPERATIONS ON THE BLADDER
SUPRAPUBIC CYSTOTOMY
DIVERTICULECTOMY

RESECTION OF THE BLADDER
TOTAL CYSTECTOMY FOR CANCER

In this chapter it has seemed advisable to include the following

- 1 Operations on the bladder
- 2 Other therapeutic procedures such as
 - (a) Transurethral and transvesical treatment¹ of bladder tumors with fulguration, diathermy and radium
 - (b) Operative cystoscopy

OPERATIONS ON THE BLADDER

Only the more commonly employed operations will be described. These are the following

Suprapubic cystotomy
Diverticulectomy
Resection (including subtotal or total cystectomy)
Operations for bladder fistulae
Operations for exstrophy of the bladder
Lithotrity

SUPRAPUBIC CYSTOTOMY

This consists essentially in opening the bladder (distended with air or water), extraperitoneally, above the pubis

Technical

ANESTHESIA, POSITION AND FILLING OF BLADDER General anesthesia is rarely if ever indicated, except in children. If the cystotomy is a preliminary step in the removal of the prostate, it is necessary to use a combined sacral (Figs 168 and 169) and local (Fig 164) (field block) anesthesia (see Chapter 9). The latter method alone suffices for cases in which the bladder is simply opened for purposes of drainage. For cases in which extensive resections or application of diathermy are contemplated, it is necessary to supplement the sacral and field block methods, with general anesthesia.

Although some operators do not attempt to change the ordinary supine position of the patient on the operating table, it will be found to be more satisfactory, for the majority of operators, to use the Trendelenburg position, i.e., raise the lower extremities and pelvis, because it aids in displacing the intra-peritoneal viscera from the field of operation. In cases in which the bladder is to be widely opened, such as extensive resections, diverticulectomy, diathermy

¹By transurethral is understood the use of the high frequency current or the implantation of radium with the aid of the cystoscope (Figs 676 and 675), while the term transvesical is now commonly employed to designate the application of diathermy or implantation of radium, through a suprapubic incision.

or radium implantation of large bladder tumors a good exposure is rarely possible without a Trendelenburg position.

The bladder is filled by injecting sterile water or boric acid solution

One can safely fill the bladder until the suprapubic dullness has attained a width of three fingers

It should be remembered however, that there is a great variation in the size of the bladder even under normal conditions (see Fig 40 in Chapter 2) If a cystoscopy or a cystography has preceded the operation accurate information will be available but if not then the presence of resistance to the injection of more fluid is the best guide as to when the bladder is sufficiently distended.

INCISION AND SUBSEQUENT STEPS

The incision should begin immediately over the symphysis and in the average case extended about six to eight cm upwards being careful to keep in the median line For extensive operations and in stout individuals a longer incision is often called for The operator should stand as a rule on the left side of the patient. After dividing the skin subcutaneous fat and anterior sheath of the recti muscles the latter are separated bluntly as close to their line of union as possible The closer one clings to the upper border of the symphysis as a guide the less apt are such accidents as opening the peritoneal fold to occur As soon as the perivesical and subperitoneal fat is reached one begins with a gauze sponge to push this fat upwards

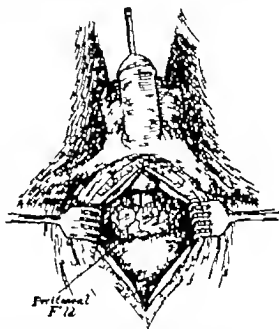


FIG 663—Operative field in Suprapubic Cystotomy The bladder has been distended with fluid so that the venous plexus on its vertex and anterior wall help to identify the structure as the bladder The peritoneal fold is shown passing transversely across bladder It must be pushed toward umbilicus (with gauze) before opening bladder (see Fig 664)

from the symphysis until the bladder is palpated as a resistance at the bottom of the wound One can recognize the bladder by the interlacing muscle fibers and plexus of veins (Fig 663) on the exposed surface The fat which has been pushed upwards surrounds the fold of peritoneum (Fig 663) which is reflected from the anterior abdominal wall upon the vertex or dome of the bladder (Fig 37) Having identified both the bladder and peritoneal fold the latter is retracted in the midline after placing a gauze pad beneath the retractor We now use the Allis forceps (Fig 665) in preference to the catgut traction sutures shown in Fig 664

This is done so as to prevent the cystotomy opening from retracting too much behind the pubic symphysis, when the bladder is empty and thus favor formation of a fistula (see postoperative complications) If large veins pass across the line of incision it is advisable to ligate them by transfixion before opening the bladder Whether to make a transverse or a vertical (parallel to the long axis of the body) incision is a matter of choice and experience

We can see no advantage in the transverse incision and hence employ the other

In order to avoid soiling of the exposed perivesical tissues by the escaping medium with which the bladder has been distended, some surgeons prefer to insert a trocar and aspirate the contents by means of an electric suction apparatus. One should avoid as much as possible, very extensive mobilization of the bladder, unless the cystotomy is only one step of an extensive resection or diverticulectomy. There is free communication of the cellular tissue (Fig 306) around the bladder, hence infection may spread very rapidly, if there has been much undermining of the abdominal wall or of the space between the bladder and pubic symphysis.

FIG 664—Second step of suprapubic cystotomy. The peritoneal fold (see Fig 663) has been well retracted and two traction sutures have been inserted through wall of bladder before incising latter along dotted line as close as possible to upper end of bladder. Instead of traction sutures some prefer to use the Allis forceps (Fig 665).

CLOSURE OF THE BLADDER AND ABDOMINAL WALL INCISIONS. There are two meth-

ods of treatment after the bladder has been opened

(a) Primary closure, i.e., immediate and complete suture of the cystotomy opening, only the prevesical space being drained. The bladder is drained by a urethral retention (Fig 101) catheter.

(b) Drainage of the bladder through the cystotomy opening.

The first named procedure might be regarded as the ideal method and is employed by a few after suprapubic prostatectomy. Until we have had more experience, however, it is safest to employ drainage in all cases.

COMPLICATIONS DURING THE OPERATION. These can occur during or after the operation. The only one of consequence, in the former group, is opening the fold of peritoneum. This can occur during the stage when it is being pushed

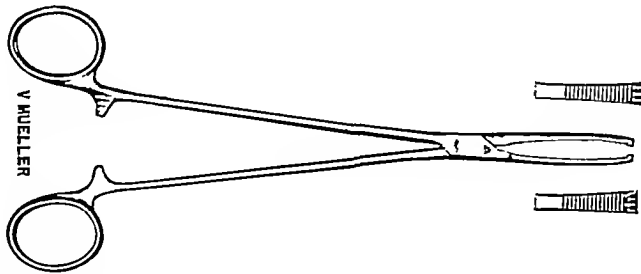


FIG 665—Allis forceps (Courtesy of V Mueller and Company)

away from the dome of the bladder (Fig 37) or when it is mistaken for the bladder and incised. This accident is not rare when the bladder is small and lies to a greater extent behind the symphysis, i.e., rises very little above it although fully distended. It can also occur when there has been a pericystitis so that it is difficult to push the peritoneal fold upwards. It is also a common

occurrence when the bladder has been incompletely filled. The last of these is avoidable but under the first named two conditions opening of the peritoneal fold is excusable. As a rule, no harm will result from opening the peritoneal fold if immediate closure follows. Hemorrhage during the operation is insignificant but all bleeding points, especially veins should be immediately ligated.

Complications after the Operation. Infections of the abdominal incision and perivesical tissues are the most common and of these two pericystitis is



FIG. 666—Straight lithotomy forceps. (Courtesy of V. Mueller and Company)

the more important. The perivesical space is composed of two parts (a) an anterolateral (Fig. 306) which contains considerable fat and is known as the space of Retzius (Fig. 37) and a posterior or retrovesical portion (Fig. 306). The latter lies between the posterior inferior surface of the bladder and the rectum. It is limited above by the vesicorectal fold of peritoneum and below by the prostate. This retrovesical space is more marked in males than in females.

Infection can either involve the anterolateral space of Retzius alone, or both this and the lateral and retrovesical portions. For this reason it is important in badly infected cases to provide for ample drainage of the perivesical tissues, at the time when the bladder is opened.

The majority of operators drain the bladder with a Pezzar (mushroom) or a Malecot (two or four wing) type of catheter (see Chapter 4) the incision being closed around the tube two sutures passing through the wall of the drain. At the same time it is advisable to insert one or more ordinary rubber tubes into the pre and retrovesical spaces. As an additional precaution the bladder can be attached (at least one suture on each side of the incision) to the rectus muscle and its anterior sheath. This prevents the bladder from retracting too much. We have found this last described method of especial value in stout individuals. The tube which drains the bladder should be held in place with chromic gut sutures and no effort made to withdraw the tube for a week at least. In infected cases

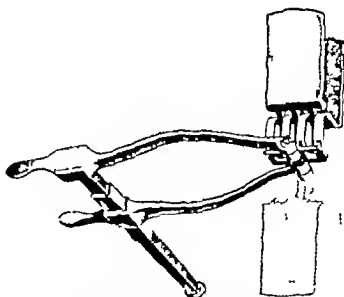


FIG. 667—Mason Judd bladder retractor self retaining, with swivel blades. (Courtesy of V. Mueller and Company)

DIVERTICULECTOMY

We have considered the indications for the removal of bladder diverticula in Chapter 26, and will only take up the technic here

There are two principal methods, viz

(a) The intravesical

(b) The combined intra- and extravesical

Intravesical Diverticulectomy

This is the method of choice of Dr Hugh H Young and his associates. It is, however, less commonly employed elsewhere.

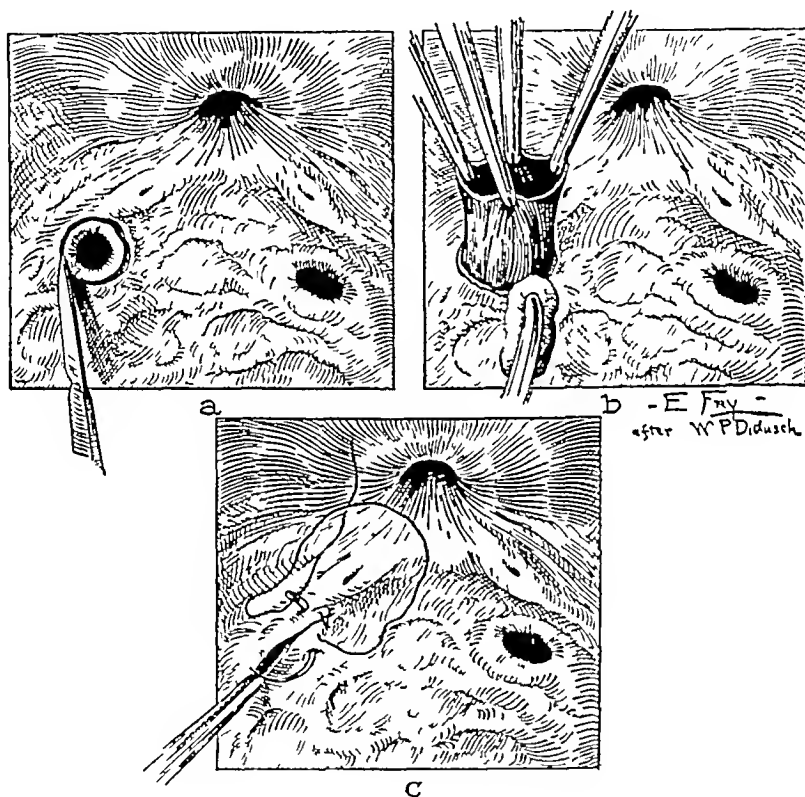


FIG 668—Intravesical diverticulectomy A Incision around opening of diverticulum
B Diverticulum drawn upward
C Closing incision (Courtesy of the Mayo Clinic)

In his first case operated in 1904, Young made an incision around the orifice of the diverticulum (a, of Fig 668) and the diverticulum drawn (b, of Fig 668) into the bladder. Later (1922) Geraghty found that in certain cases, removal of the mucous membrane alone, was sufficient for cure in cases where the entire sac could not be removed by Young's original technic. In 1918, Young published seven cases in which suction had been employed to assist in drawing the diverticulum into the bladder.

YOUNG'S TECHNIC is to place the patient in a marked Trendelenburg position and after opening the bladder widely, to use a self-retaining retractor. Suction is applied to the bottom of the sac and the latter completely everted into the bladder lumen. If the ureter is in no way associated, as shown by previous cystoscopic examination or inspection of the sac, a circular incision is made around the diverticulum through the mucosa and submucosa and the

entire sac freed by blunt dissection. Great care must be used not to dissect too deeply or to enter the peritoneum. After providing for extravescical drainage of the bed from which the sac has been removed the bladder opening is sutured intravesically.

Where suction fails to draw up and evert the mucus membrane Young employs either traction with forceps (b of Fig 668) or extravescical pressure to push the mucus membrane into the bladder. He believes that Intravesical diverticulectomy is simpler safer less bloody and much to be preferred to the extravescical method of Czerny, to be described next.

Combined Intra and Extravesical Diverticulectomy

This is the method preferred by the majority of operators because (a) the removal of the mucus membrane alone as suggested by Geraghty is only

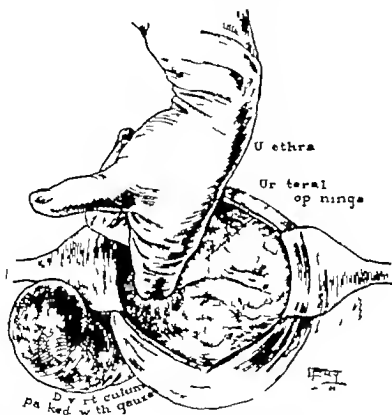


FIG. 669.—Combined extra and intravesical diverticulectomy. The finger is inserted into the diverticular cavity which has been packed with gauze. The sac is now freed by gauze or if necessary by sharp dissection. (Courtesy of Dr. Verne C. Hunt of the Mayo Clinic.)

possible. In a small percentage of cases there being such firm adhesions as to render its separation from the fibrous wall of the sac impossible (b) because of the difficulties even encountered by Young in attempting to evert by suction into the bladder a sac which is very adherent to perivesical structures as the result of long continued infection (peridiverticulitis) (c) one has a much better exposure of the peritoneum, rectum, larger blood vessels² and the separation of the sac very much easier than by the intravesical method.

TECHNIC. An extreme Trendelenburg position, wide opening of the bladder and good retraction (Fig. 667) are essential preliminaries. General anes-

thetia is preferable in difficult cases. The cavity is packed with gauze and a finger inserted into the orifice (Fig 669) while a sufficient exposure of the perivesical tissues is made to enable the exterior of the sac to be freed from its bed by gauze or if necessary, sharp dissection. After the sac has been completely mobilized, (Fig 669) an incision is made around the edges of the orifice (a, of Fig 668) and the sac removed. The opening in the bladder wall is sutured and the bed drained extravasically. If the sac is covered by peritoneum, no harm will result from opening the peritoneal cavity, packing the intestines away while the sac, with or without its serous covering, is excised. The peritoneal opening is sutured as soon as possible with fine chromic gut.

Marion (Paris) varies the above technic, by immediately dividing the intervening bladder wall between the orifice of the diverticulum and the original cystotomy incision. This is of great assistance in mobilization of the sac and we can warmly recommend it from personal experience.

CARE OF THE URETER As was stated in Chapter 26, the ureter may open, either within the sac itself or in close proximity to its orifice. Not rarely the ureter winds around (Fig 314) and is in intimate relation to the outer aspect of the sac. Cystoscopic examination should always precede a diverticulectomy. It is only by this method, aided by cystography, ureterography and ureteral catheterization, that an accurate preoperative study of the relations of the ureter and sac is possible.

Some operators (Illyées) routinely introduce a ureteral catheter immediately before a diverticulectomy, and this may perhaps, in time prove to be the safest procedure. It is especially valuable in showing the relation of the ureter to the outside of the sac. Every effort should be made to conserve the ureteral orifice. Young (loc cit) was able to do this by a plastic operation. If this cannot be done, the ureter should be reimplanted (see latter part of this chapter), unless it is so dilated and there are other changes, incident to upper urinary tract infection, as to render conservatism inadvisable.

DIVERTICULECTOMY SHOULD ALWAYS BE PRECEDED OR FOLLOWED BY REMOVAL OF ANY BLADDER NECK OBSTRUCTION Every effort to lessen the infection in the bladder and sac should precede the diverticulectomy. Drainage of the bed extravasically and closure of the bladder wall around a Pezzar or Malecot tube, as in suprapubic cystotomy, follows the removal of the sac.

RESECTION OF THE BLADDER

Removal of a segment of the bladder wall constitutes a portion of the operation in (a) fistulae (b) diverticulectomy (c) radical removal of rectal, uterine, etc., cancers with involvement of the adjacent bladder wall, and finally, (d) cancer arising in the vault (dome) of the bladder. We have omitted from this, resection for solitary ulcer due to interstitial cystitis and also operations involving removal of a segment of the wall, for nonmalignant papilloma. Resection for elusive ulcer was discussed in Chapter 25 and the abandonment of bladder resection for simple (nonmalignant) papilloma was taken up in Chapter 27. We only wish to reiterate here, that the results from resection for elusive ulcer were so unsatisfactory, that it has been superseded by endovesical fulguration. In the case of single or multiple (apparently benign) papillomata, cutting methods formerly employed, were found to be followed by such a large

percentage of recurrences due to *unplantation* in other parts of the bladder (especially the suprapubic incision) as well as local recurrences i.e. at the site of operation that fulguration for the smaller and more accessible and diathermy or electric cautery for the larger or less accessible (applied through a suprapubic incision) has almost entirely supplanted the older cutting methods. The only exceptions are those cases in which the individual urologist feels that his own experience leads him to believe that the introduction of radium in the form of the element or emanation (see below) offers a better prospect for cure, than the use of electricity in some form or bladder resection.

Indications. Before attempting to take up the technic of the bladder resection, it is well to direct attention to the fact that it is impossible as pointed out in Chapter 27 (under Treatment of Bladder Tumors) at the present time, to lay down any hard and fast rules for the indications for resection. Some urologists of large experience believe radium should be employed for all tumors of the epithelial type others equally as competent feel that resection no matter where the tumor is located is indicated and there are other "Schools" who feel that endo- or transvesical methods in which electricity is the therapeutic agent is the method of choice. We have explained our own viewpoint in Chapter 27 which is that resection of the bladder is only to be considered in tumors involving the vault or dome but not those involving the other portions or the trigone.

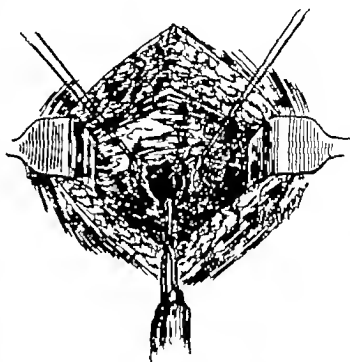


FIG. 670.—Method of opening the bladder with the cautery or radioknife as first suggested by Beer

The immediate mortality and unsatisfactory end results in the last named localization is for the majority of urologists a contraindication to their employment. For these reasons, we will limit the description of the technic of bladder resection to the vault or dome.

Technic of Bladder Resection

The bladder is approached through the incision in the abdominal wall ordinarily employed for suprapubic cystotomy. Filling the viscus with air is preferable to water on account of the danger of detachment with subsequent reimplantation of tumor particles when a liquid is used to distend the bladder. Beer recommends opening the bladder with the electric cautery as shown in Fig. 670 a plan which we usually follow.

There are two groups of cases

- (a) Those in which the overlying peritoneum is involved (Fig. 671)
- (b) Those in which there is no apparent extension of the tumor to the peritoneum.

THE IDEAL OPERATION is one based on the principle, first suggested by Voelcker, and termed deperitonealization. He found that it is impossible to detach the peritoneum over a small area at the vault or dome³ of the bladder. By making an incision (before opening the bladder) so as to leave this portion of the peritoneum attached (Fig 671), it is a comparatively easy task to mo-

FIG 672

FIG 671

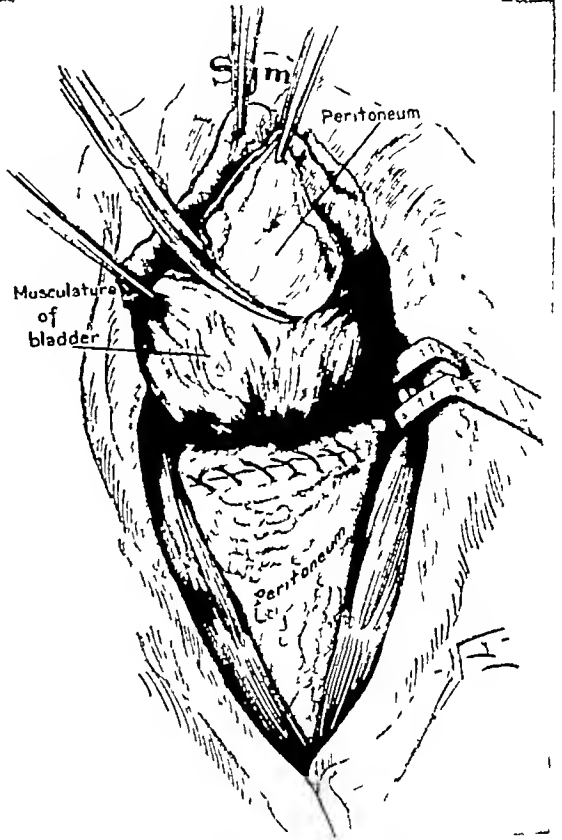
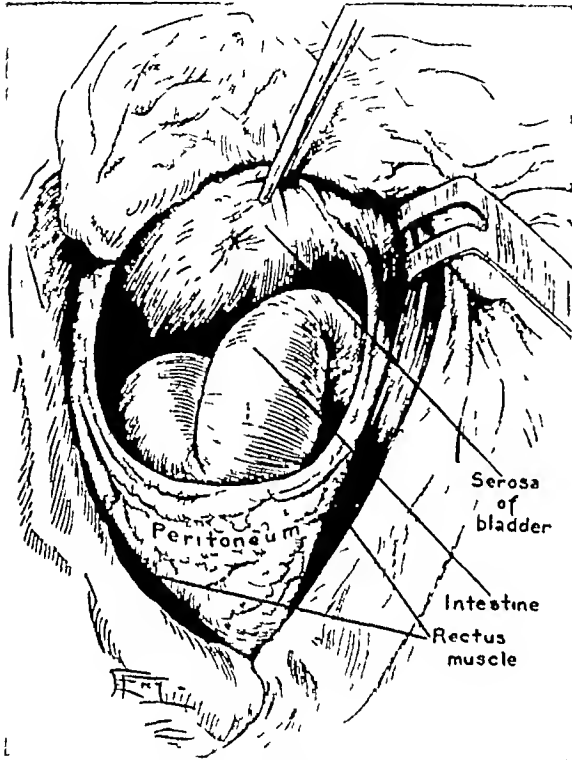


FIG 671—Resection of bladder. The peritoneal cavity has been opened, leaving intact the portion of dome to which peritoneum is attached (Courtesy of the Mayo Clinic)

FIG 672—Resection of bladder. The peritoneal cavity has been excluded by a double row of sutures. Removal of dome of bladder has been begun (Courtesy of the Mayo Clinic)

bilize the entire upper portion of the bladder. The opening in the peritoneum is immediately closed with fine chromic gut sutures or one can close the peritoneal cavity by suturing the anterior layer of peritoneum (Fig 672), to the base of the bladder below the affected area, before resection is begun. One need not fear any infection of the peritoneum, if its contents are well walled off by gauze packs.

After exposing the bladder, it is opened and the extent of the tumor determined. If the involvement is not too extensive, the peritoneum is displaced with the aid of gauze sponges and then the entire thickness of the bladder, at least one-half inch away from the growth, is divided with the electric cautery in preference to a scalpel or scissors. There is comparatively little bleeding by this method and the reconstruction of the bladder presents no special difficulties unless the ureter is involved. If this is the case, reimplantation by some simple method (Fig 743) is indicated. Two rows of sutures should always be

³ The term "dome" or vault is more commonly employed at present than the older one "vertex."

used in closing the bladder wall with size 0 chromic catgut. One suture includes all of the wall except the mucosa the second inverts the first line and also includes the entire thickness of the wall except the mucosa. The principle of such a bladder closure is that of the double Lambert suture so commonly used in gastro-intestinal surgery.

After resection of the bladder whether by the intra or extraperitoneal methods, a retention catheter (preferably of the Pezzar or Malecot (Fig 69) type) is left in the bladder (Fig 673) and provision made for ample drainage of the perivesical space (Fig 306). The abdominal wall incision is closed in layers around these drains.

TOTAL CYSTECTOMY FOR CANCER

Carcinoma involving the vault (dome) of the bladder as stated above is the only location which is accessible to resection. Carcinoma of the vault or dome of the bladder is extremely malignant and metastasizes to the liver occur by way of the lymphatics which follow the course of the obliterated hypogastrics. For this reason total cystectomy followed by transplantation of the ureter has been proposed. The most recent contribution to the subject of total cystectomy is that of Higgins (Surg. Gynec. and Obst. 1938 66 549).

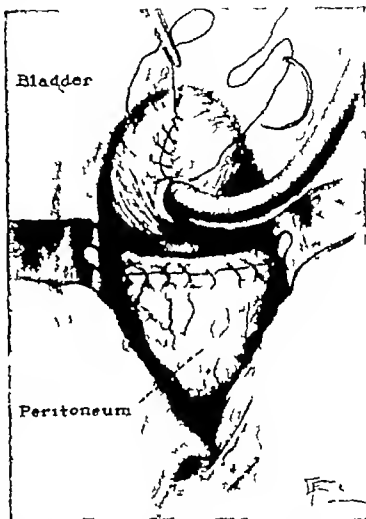


FIG 673—Closure of the bladder around drainage tube after resection of dome and adjacent areas for carcinoma. (Courtesy of the Mayo Clinic.)

The indications for such a radical operation according to Higgins, are

- 1 When the carcinoma is located at the base of the bladder and the ureteral orifices are encroached upon or the vesical sphincter is so involved that adequate local treatment would exert a destructive action on the ureteral orifice or would cause incontinence

- 2 When more extensive single or multiple infiltrating tumors are present

- 3 When multiple recurring tumors develop rapidly and cannot be controlled by fulguration so that they eventually fill the bladder

In addition to these 3 groups of cases certain other factors must be taken into consideration before the radical operation is recommended

- 1 Renal function must be satisfactory preferably in both kidneys but

at least normal in one kidney In 3 instances Higgins transplanted the ureter from the normal kidney into the bowel, finally performing the cystectomy after removing the opposite kidney because of infection and complete loss of function as the result of a bladder tumor obstructing the corresponding ureter

2 The presence of metastases or evidence of local extension of the malignant lesion must be taken into consideration If, at the time of transplantation of the ureters, clinical evidence of extension of the carcinoma beyond the confines of the bladder is noted, the radical operation is inadvisable Palpation of the regional lymph nodes and those at the bifurcation of the aorta is a routine procedure As these glands are not removed in their entirety if involved, local recurrence would obviously ensue Roentgen-ray study to exclude the possibility of metastasis to the chest is advisable in all cases

3 Intravenous urograms should be made to demonstrate that the calibers of the ureters are such that their reimplantation is technically possible

4 When radical excision is impossible or not enough radium could be implanted, only total cystectomy with transplantation of the ureters offers a chance of cure Finally, if the cystogram (Fig 328) shows more involvement than could be found by cystoscopic examination, only total cystectomy can be considered

Pre-operative Preparation for Total Cystectomy as Suggested by Higgins (loc cit)

1 A liquid, non-residue diet is supplemented by candy, glucose, and gelatin

2 One thousand cubic centimeters of a 10 per cent solution of glucose are administered intravenously each day The glucose is given with saline solution if the kidney function is not impaired but, if the renal function is decreased, distilled water is substituted for the saline solution

3 Magnesium sulphate is administered orally each day One ounce of magnesium sulphate is dissolved in 8 ounces of water, 1 ounce of this mixture being taken every half hour starting at 7 a m None, however, is used on the day prior to the operation

4 The bowel is cleansed with an enema daily

5 Provided there are no other complications, the number of days of preparation before operation depends upon the renal function and the cleanliness of the bowel When all enemas return clear, the bowel is considered clean The day before operation, an enema is given both in the morning and at night

6 Three doses of paregoric, each of 2 drams, are prescribed at intervals of 2 hours, usually from 4 to 8 o'clock the night before operation

7 Blood transfusions are used when indicated by the condition of patient and the blood picture

8 Complete study of the upper urinary tract is made by tests of function and intravenous urography

9 Urinary antiseptics intravenously or orally are administered as indicated

10 Miscellaneous supportive measures are employed as necessary

Anesthesia

Spinal anesthesia has been the anesthetic of choice The complete relaxation induced by this type of anesthesia facilitates the ease with which exploration of

the abdomen for metastases may be accomplished without excessive manipulation of the intestines. Similarly exposure may be adequately secured without undue or excessive packing off of the operative field with numerous tapes.

More important is bringing the ureter down to the colon so that the danger of tension on the ureter or kinking of the ureter does not occur a condition which is always a possibility. If the anastomosis is performed with the rectosigmoid delivered well up into the incision.

Obviously if contra indications to the use of spinal anesthesia exist, it is not used and gas-ether anesthesia is employed.

Operation

As to the transplantation of the ureters either the Coffey No 1 or the Higgins (Surg Gynec. and Obst 1933 57 359) have been employed at the Cleveland Clinic in 34 cases of total cystectomy. If the Coffey No 1 technic is used only the right ureter is transplanted at the first sitting and the left side, ten to twelve days later. The abdomen should be explored at the first sitting for metastases in the regional (Fig 44) and retroperitoneal lymph nodes as well as in the liver. The Coffey No 1 technic is to be preferred for cases with poor renal function or if there is evidence of ureteral dilatation. If the ureter is of normal caliber on both sides Higgins transplants both at the same sitting by the transfixion suture method unless an excess of mesenteric fat is present.

Thus individualization is necessary and the operative procedure to be employed depends upon the familiarity of the surgeon with the various operative technics and the clinical findings prior to and during the operation.

The use of ureteral catheters is usually unnecessary. Higgins has utilized the catheter principle in two instances in which the ureters from solitary (congenital) or remaining kidneys were transplanted into the rectosigmoid to eliminate the possibility of temporary obstruction.

Postoperative Care

An exacting postoperative regimen is essential and the following routine has given the most satisfactory results in our hands.

- 1 The patients are maintained in a supine position for at least 8 hours if spinal anesthesia is used then they are placed in Fowler's position.

- 2 The blood pressure is taken every 15 minutes until it returns to normal.

- 3 No fluids are administered by mouth for 48 hours and then small amounts of water are taken orally for 12 hours. During the following 12 hours clear fluids are started with 1 ounce hourly and this amount is gradually increased. A low residue diet is then given for a period of 5 to 7 days.

- 4 The fluid intake is maintained at 3,000 cubic centimeters daily. For the first 2 days, 2,000 cubic centimeters of 10 per cent solution of glucose is administered intravenously and 1,000 cubic centimeters of saline solution infusion daily. After this period, fluids are given intravenously as indicated by a study of the blood chemistry and the amount of fluid taken by mouth.

- 5 Narcotics are given as necessary.

- 6 A rectal tube is inserted at the time of operation. This may be changed but is replaced and left in the rectum for a period of 8 to 10 days. The rectal tube is irrigated gently at intervals of 2 to 3 hours to insure patency. When the transfixion suture technic is employed gentle traction is made on the rectal tube at the end of 24, 36 and 48 hours until the tube containing the silk sutures is expelled. A plain rectal tube is then reinserted for a period of 5 to 7 days.

7 Studies of the blood chemistry (urea and creatinine) are made daily until the levels return to normal

8 Ten cubic centimeters of salihexin are combined with the intravenous glucose as a urinary antiseptic for the first 3 or 4 days following operation

9 General supportive measures are prescribed as indicated

Complications

The immediate complications are (1) peritonitis (2) acute renal infection (pyelonephritis) (3) temporary ureteral obstruction

Temporary blocking from edema may take place. If it persists, one can do temporary nephrostomy.

Immediate use of urinary antiseptics as a preventive measure is also made such as mandelic acid by mouth.

Later complications may be (1) dilatation of ureters and hydronephrosis (2) renal infection, (3) impairment of renal function, (4) recurrence of malignancy.

In some instances excretory urographic studies reveal the presence of hydro-ureters and hydronephrosis years after implantation of the ureters into the bowel. In other cases, similar studies reveal the ureters and kidneys to be in fairly normal condition years after operation. The causative factors responsible for the dilatation of the ureters are not clearly understood. It does appear, however, that with experience and greater refinements in operative technic, the incidence of this complication is progressively diminishing. Even though this complication may occur, years of comfort are added to the lives of the patients and they may be restored to society for a long period of time before succumbing to other diseases remote from the one for which operation was performed.

Some patients may be free from urinary sepsis for years, in fact, we have patients in whom evidence of renal infection is absent 10 to 15 years following transplantation of the ureters. The late infection usually occurs in patients in whom stasis, dilatation of the ureters, and hydronephrosis are demonstrated by intravenous urography. These patients may have periodic attacks of renal infection which subside rapidly upon the administration of urinary antiseptics. It is undoubtedly true that some degree of ureteral obstruction, with resulting stasis, is the responsible etiological factor in this group.

The presence of late ureteral obstruction frequently antedates impairment of renal function. When a superimposed renal infection occurs, renal function may be damaged rapidly. If pyelonephritis does not occur, however, the function may not be impaired to any pronounced degree for years.

OTHER THERAPEUTIC PROCEDURES

TRANSVESICAL DIATHERMY FOR BLADDER TUMORS⁴

For the electrocoagulation of malignant or potentially malignant vesical tumors, free access is gained, by widely opening the bladder through suprapubic cystotomy. In order to place the vesical incision to the best advantage it is advisable to determine beforehand the location of the tumor by cystoscopy, cystography and finally by palpation, after the anterior aspect of the viscus is exposed.

⁴We are indebted to Dr. Gustav Kolisher for this section on the use of "Surgical" diathermy.

Proper visualization of the neoplasm and systematic progress of the coagulation is insured through the complete removal of the distending fluid with an electric suction apparatus after the bladder is incised.

Whether the interior of the viscus is exposed by means of a self retaining retractor or not, is a matter of choice. It is important however, that the traction should not be exerted in a lateral but in a vertical i.e. cephalocaudal direction. This detail is of particular importance in tumors occupying the base and retro-trigonal areas.

Electrodes

The flanges of the retractors should be short so as not to place the area of operation beyond easy access. The electric current as a rule is applied by placing the inert electrode over the sacral region of the patient while the coagulation of the tumor is obtained with a small active electrode (Fig. 674)

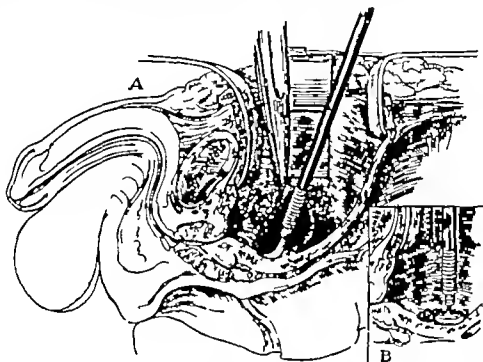


FIG. 674.—Diathermy of bladder tumors.

A. Method of dividing pedicle of a large papillary tumor with electrode through supra pubic incision.

B. How to use diathermy electrode at base of a tumor after intravesical protruding portion has been thoroughly burnt.

Operation

In tumors located in the mobile part of the bladder wall the growth may be caught between two active electrodes of equal size. For the coagulation of malignant tumors it is preferable to use disc shaped electrodes (Insert of Fig. 674) and not needle shaped ones.

It is unavoidable to cause sparking with needles. Sparks not only coagulate the tissues but also produce comminution which is apt to carry infection to the underlying structures besides the concomitant interruption and slowing up of the current favors the production of undesirable physiologic side effects.

The size of the electrodes is always selected so that they will be smaller than the surface diameter of the tumor. This permits ocular control of the effect of the coagulation at the periphery of the tumor.

All active electrodes to be used, are first tested by observing the depth and horizontal extent of coagulation, resulting from various magnitudes of current, on a piece of fresh meat. In cases of tumors located at the base of the bladder, an assistant inserts two fingers into the rectum or into the vagina, respectively, of the patient. The intensity of the heat during the progress of coagulation, is reported to the operator, thus informing him that the danger line is approaching.

Watching the reaction on the tumor around the periphery of the electrode together with the other items mentioned, will furnish the operator with a pretty fair estimation concerning the magnitude of the current to be employed and the necessary duration of the contact between tumor and active electrode.

From a visual standpoint, the coagulation is considered finished when the site of the growth is reduced to the level of the surrounding bladder wall, and when the area subjected to the coagulation, appears to be perfectly dry.

In dealing with tumors that protrude markedly into the vesical cavity, it is advantageous to carbonize their free surface prior to the definite coagulation, in order to prevent any implantation of viable tumor cells during the subsequent manipulations.

This is especially important in growths of a papillomatous character with a cauliflower like surface.

In pedunculated tumors, the whole operation is facilitated by grasping the carbonized top of the growth with a spoon forceps, and by an upward pull, make the pedicle accessible.

The pedicle is then severed by means of an endothermic knife closely to its vesical insertion. Now the stump and the adjacent area is thoroughly coagulated with the disc-shaped electrode (Fig 674).

In very fleshy tumors, it is advantageous to proceed by layers, with the coagulation. The first and if advisable, the second scab or crust produced by coagulation, is removed with a sharp curette, and then the underlying structures are again coagulated.

The bladder wall and the abdominal integuments are closed in the usual way leaving an opening for the drainage tube (Fig 673).

Cystotomy and tumor coagulation may very satisfactorily be performed under sacral block anesthesia, combined with local infiltration of the abdominal wall. If general anesthesia is employed, safety is only guaranteed by the use of nitrous oxide gas.

Ether or ethylene anesthesia always carries with it great danger of explosion. Screening off of the diathermic generator, for obvious reasons, does not furnish any reliable protection from explosion.

RADIUM IN BLADDER CANCER⁵

The radium emanation tubes were originally designed by Duane of Boston, and put into practical use in treating deep seated malignancies, by H. H. Janeway of New York. They were at first known as "bare tubes" in this country. More recently, they have been called "seeds." They are small capillary tubes of glass filled with the emanation from radium, which is a gas, but has all the

⁵We are indebted to Dr. Joseph Muir of New York City for this section.

properties of radium element so far as its therapeutic employment is concerned. The rays given off by the element however, remain constant in intensity, while those from the emanation decrease in intensity at a known rate so that after a definite length of time an emanation container becomes wholly inert.

The needles used at first were usually of steel but these were replaced by platinum or gold. When radium emanation came into more general employment the custom of placing radium element itself in the needle was rapidly abandoned for a tiny glass container of radium emanation could be carried in a far finer needle than was possible where radium element of equal therapeutic value was employed. The platinum needle served to cut off most of the caustic beta radiation which caused such extensive necrosis around the steel ones and thus trauma and destruction of sound tissue by sloughing were both minimized.

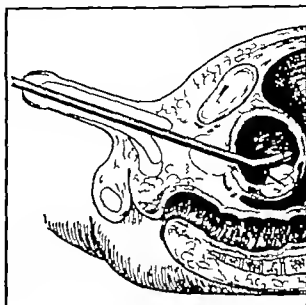


FIG. 675.—How to insert the removable platinum filtered radon seed into a bladder tumor with the aid of the operating cystoscope. (Courtesy of Dr. Joseph Muir.)



FIG. 676.—Close-up view of endovesical implantation 2 cm. apart of removable platinum filtered radon seeds. (Courtesy of Dr. Joseph Muir.)

The implantation of these emanation seeds was greatly facilitated by a device consisting of an implanting needle equipped with a loading slot (Figs. 675 and 676) which permitted even a large growth to be evenly seeded throughout and made it possible to deposit several seeds in the channel made by a single insertion of the needle point thus increasing the accuracy of dosage and reducing operative trauma. This very simple modification abolished most of the mechanical difficulties which had hitherto attended implantation.

REMOVABLE SEEDS

In 1923 Rigaud head of the Paris Radium Institute suggested enclosing the radon directly in metal containers—that is making

“seeds of gold or platinum instead of glass. Implantation of the bladder with the removable platinum radon seed can be done either cystoscopically or through the suprapubic incision but its usefulness in connection with cystoscopic work, especially commends it.

One employs a seed filtered by 0.3 mm of platinum, capable of delivering a dosage of $333 \frac{1}{3}$ millicurie hours, that is, 2.5 millicuries of radium emanation, destroyed in ten days time. These seeds are placed in the neoplasm (Fig 676) at a distance of 2 cm apart.

The Muir implanter is passed through the channel of an operating cystoscope (Fig 675). The site for the deposit of the first seed having been selected, the point of the implanter is thrust into the neoplasm and the seed placed in the loading slot. This seed pushed by the plunger, is carried into the tissues to

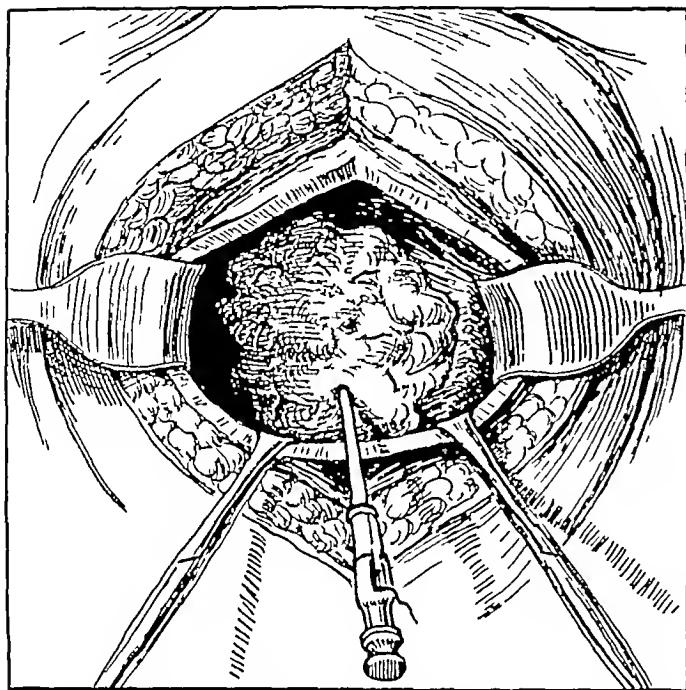


FIG 677—Suprapubic implantation of platinum-filtered, removable radon seeds into a cancer involving the trigone (Courtesy of Dr. Joseph Muir)

a predetermined depth. When it reaches this depth, its progress is automatically halted by the shoulder of the instrument, which prevents the point from advancing beyond a certain distance. When the instrument is withdrawn, the seed remains in place, the thread attached to it being plainly visible (Fig 676), protruding from the point of entrance. The first seed deposited thus serves as a landmark from which the proper location of all subsequently to be implanted (Fig 675), can be readily ascertained. The total number, of course, depends upon the size of the growth, and the estimated invasion of the surrounding

bladder wall, by possible malignancy. "In general, three platinum radon seeds will satisfactorily irradiate an area which would have required from fifteen to twenty 'bare tubes'."

REMOVAL

When the period of exposure to radiation has expired—this is ordinarily nine or ten days—the seeds are withdrawn through the cystoscope, using either an ordinary cystoscopic forceps or an instrument especially designed to meet this need. A patient accustomed to cystoscopic procedures will not even require an anesthetic, though in hypersensitive or neurotic subjects, some sort of anesthesia will usually be necessary. The threads attached to the seeds must be cut off to a length not exceeding one centimeter, before being placed in the loading-slot, for if too long, a thread is left protruding from the bladder wall and may become entangled in the cystoscope as that instrument is withdrawn, and the seeds thus displaced, or even dislodged entirely. With the exercise of a little care and deliberation, however, such accidents can be readily avoided. Instead of implantation of the "seeds" endovesically, many prefer to open the bladder through a suprapubic incision and implant the platinum filtered seeds under control of the eye, as shown in Fig 677.

Transurethral Operative Procedures. The following (except prostatic resection for which see Chap 49) are frequently employed

- 1 Fulguration of papillomata (electrocoagulation) or of a cystic dilatation
- 2 Removal of foreign bodies small calculi etc
- 3 Division of lips of ureteral orifice
- 4 Implantation of platinum or gold filtered radium seeds.
- 5 Removal of tumor tissue for microscopic study
- 6 Lithotripsy

The fourth of these was taken up earlier in this chapter Lithotripsy was described in Chapter 26

Although some urologists still consider the removal of portions of bladder tumor tissue of value we believe that the opinion of the majority is that which was expressed in Chapter 27 This view briefly is that one cannot rely upon such a microscopic examination as to the benign or malignant nature of a given tumor The top which is so often the only portion included in a specimen taken is apt to be benign and yet the pedicle and adjacent mucosa be already the seat of malignant changes One must learn to rely (a) upon the cystoscopic appearance as pointed out in Chapter 27 and (b) upon the clinical behavior i.e. a recurrence speaks for malignancy

1 Fulguration (Endovesical Electrocoagulation)

Aside from the comparatively rare cases of cystic dilatation of the lower end of the ureter (see Chapter 29) fulguration is chiefly employed to destroy small papillomata and also granulomas The technic as first sug-

gested by Beer has only been modified in the direction of better electrodes The latter are minute copper discs placed at the end of a flexible well insulated wire

Timberlake has recently suggested a very much simpler form of electrode The bipolar high frequency current is preferable to the unipolar The indifferent electrode is placed either over the suprapubic, thigh or sacral region (Fig 678) The active electrode is introduced into the bladder through an operating cystoscope or the foroblique panendoscope of McCarthy

ELECTROCOAGULATION IS ONLY INDICATED FOR SMALL PAPILOMATATA

See Chapter 27 If the fronds or villi obscure the pedicle (A of Fig 678) an effort should be made to reach the latter by inserting the active electrode as deeply as possible into the base of the tumor (B of Fig 678) As soon as the current is turned on a change of color is observable The whitish tinge of the tumor indicates that coagulation has occurred. In sessile papillomata and also when the pedicle is difficult to visualize it is advisable to coagulate the surface of the tumor from place to place (C of Fig 678) so as to avoid overlooking any portion The ideal method of anesthesia for a prolonged sitting is caudal block (see Chapter 9) At times a number of sittings are necessary when there are multiple tumors

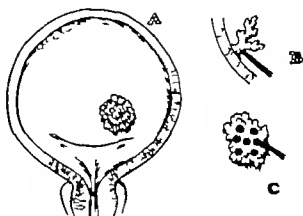


FIG. 678.—Diagrams of mode of application of endovesical high frequency current to a bladder papilloma

A. Typical location of a papilloma on posterior wall near left ureteral orifice.

B. Electrode applied to pedicle of a pedunculated papilloma before current is turned on.

C. Multiple areas on surface of tumor to which fulguration has been applied.

Papillomata at the vault or anterior wall are very difficult to reach. For those at the vault, it is advisable to allow as much as possible of the water (employed to distend the bladder) to escape. Those on the anterior wall are practically inaccessible, unless one employs some form of cystoscope with retrograde vision.

For those who have not fulgurated many bladder tumors endovesically, it is a good plan to test the degree of surface coagulation, as well as that into the

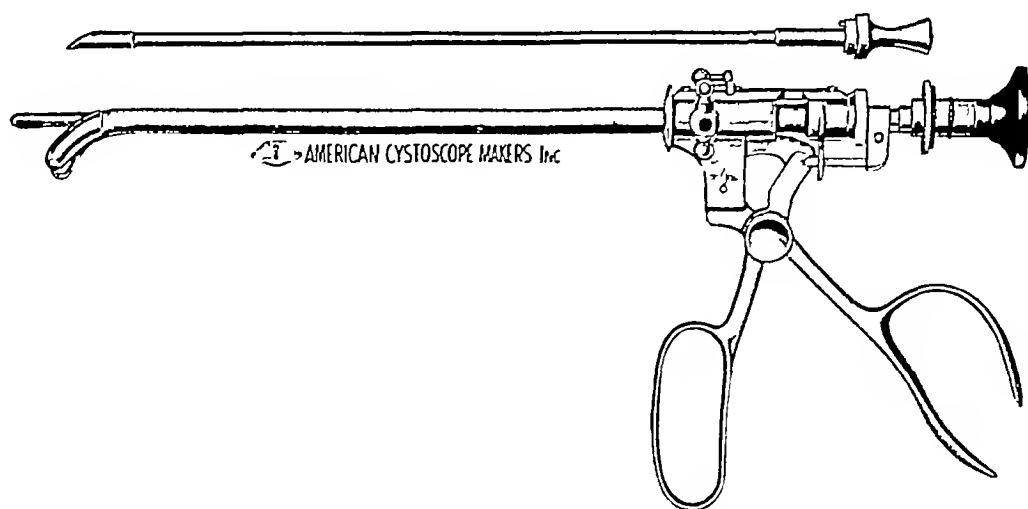


FIG 679—Improved Young cystoscopic rongeur (Courtesy of American Cystoscope Makers, Inc.)

depth, by using a thick cut of beef placed on the indifferent electrode. Occasionally severe bleeding will follow a fulguration, if one burns too deeply. As soon as the active electrode becomes coated with coagulated tumor tissue, the current should be turned off and the necrotic fragments removed before beginning to fulgurate a new area.

2 Removal of Foreign Bodies and Small Calculi

This is best carried out by introducing one of the special forceps made for this purpose through an operating cystoscope or the foroblique panendoscope.



FIG 680—From left to right: Two types of cystoscopic scissors, rongeur forceps, Bradford Lewis ureteral orifice dilating forceps (Courtesy of V. Mueller and Company)

The various foreign bodies which have been removed from the bladder were enumerated in Chapter 26. Instead of the technic just described, i.e., of using a special forceps through a cystoscope, one can introduce the original Young (Fig 679) cystoscopic rongeur or use the Kretschmer serrated jaw modification.

3 Division of Lips of Ureteral Orifice

This is indicated when a ureteral calculus cannot be expelled into the bladder because of the rigid edematous lips of the ureteral orifice. Some urologists prefer to divide the lips or reduce the edema with the electrode of a high frequency current, i.e., by fulguration. On account of the danger of subsequent stricture formation after fulguration, simple division with special cystoscopic scissors (Fig 680), is preferable, in the opinion of the majority of urologists. After such division, the calculus can often be delivered with the aid of the foreign body forceps.

CHAPTER 53

OPERATIONS ON THE KIDNEY AND URETER

SURGICAL ANATOMY OF OPERATIONS ON THE KIDNEY AND UPPER URETER

TOPOGRAPHY OF THE ILIO-COSTAL SPACE BLOOD VESSELS AND NERVES OF THE ILIO-COSTAL SPACE

RELATIONS OF THE KIDNEYS TO ADJACENT STRUCTURES

PERITONEAL REFLECTION

OPERATIONS ON THE KIDNEY

GENERAL CONSIDERATIONS

PYELOTOMY

NEPHROLITHOTOMY

NEPHROSTOMY

NEPHROPEXY

RESECTION

NEPHRECTOMY

NEPHRECTOMY

NEPHRO-URETERECTOMY

DESTRUCTION

PLASTIC OPERATION FOR HYDRONEPHROSIS

ACCIDENTS DURING KIDNEY OPERATIONS

OPERATIONS ON THE URETER

SURGICAL ANATOMY OF THE URETER

MOST FREQUENTLY EMPLOYED INCISIONS FOR

URETERAL OPERATIONS

GENERAL CONSIDERATIONS

URETEROLITHOTOMY

URETERECTOMY

DIVERSION OF URINE FROM THE BLADDER

NON INTESTINAL

INTESTINAL

SURGICAL ANATOMY OF OPERATIONS ON THE KIDNEY AND UPPER URETER

TOPOGRAPHY OF THE ILIO-COSTAL SPACE

The ilio-costal space includes only that portion of the lateral abdominal wall between the last rib and crest of the ilium. Familiarity with the structures included in this space and immediately adjacent thereto is essential because it is through these that the kidney is approached i.e., by the lumbar as distinguished from the "transperitoneal" route.

1. The Superficial (Outermost) Layer or Plane (see Fig. 681)

(A) THE LATISSIMUS DORSI arising from the outer or superficial leaf of the lumbar fascia covering the sacrospinal (erector spinae) muscle. Its fibers take an oblique course toward the axillary region, i.e. upwards and anteriorly.

(B) THE SACROSPINALIS (ERECTOR SPINAE). A long muscle whose thickness varies greatly being very wide in well developed muscular individuals.

THE SACROSPINALIS OR ERECTOR SPINAE is enclosed in a sheath formed by the two leaves of the lumbar fascia. It is often necessary to divide its fibers transversely in order to obtain a better exposure of the kidney.

(C) OBLIQUUS EXTERNUS (EXTERNAL OBLIQUE). We encounter here only the posterior bundles of origin of this muscle which run almost perpendicularly down from the tip of the last rib (Fig. 681).

The triangular space above the crest of the ilium which remains as the result of the difference in direction of the fibers of the latissimus dorsi and external oblique is termed Petit's triangle.

2. Second (Intermediate) Layer or Plane (Fig. 682)

(A) OBLIQUUS INTERNUS (INTERNAL OBLIQUE). Its fibers in this region run (Fig. 682) obliquely upwards and forwards to the last ribs.

(B) THE SERRATUS POSTICUS INFERIOR. This consists of four leaves which pass upward and anteriorly from the lumbar fascia (attached to the last two dorsal and first two lumbar vertebrae) to the four lower ribs. These muscle bundles lie superficial to the lumbocostal (costotransverse) ligament and over the pleural reflection when the latter is below the twelfth rib so that care must

be exercised not to open the pleural cavity in case it becomes necessary to mobilize the twelfth rib in difficult kidney operations

3 The Third (Innermost) Muscular Layer or Plane (Fig 683)

(A) **TRANSVERSUS ABDOMINIS (TRANSVERSALIS MUSCLE)** This muscle is poorly developed in the kidney region. One usually encounters the transversalis fascia or aponeurosis, which can be recognized by its whitish color. After its division, the pararenal fat protrudes. This aponeurosis is formed by the union

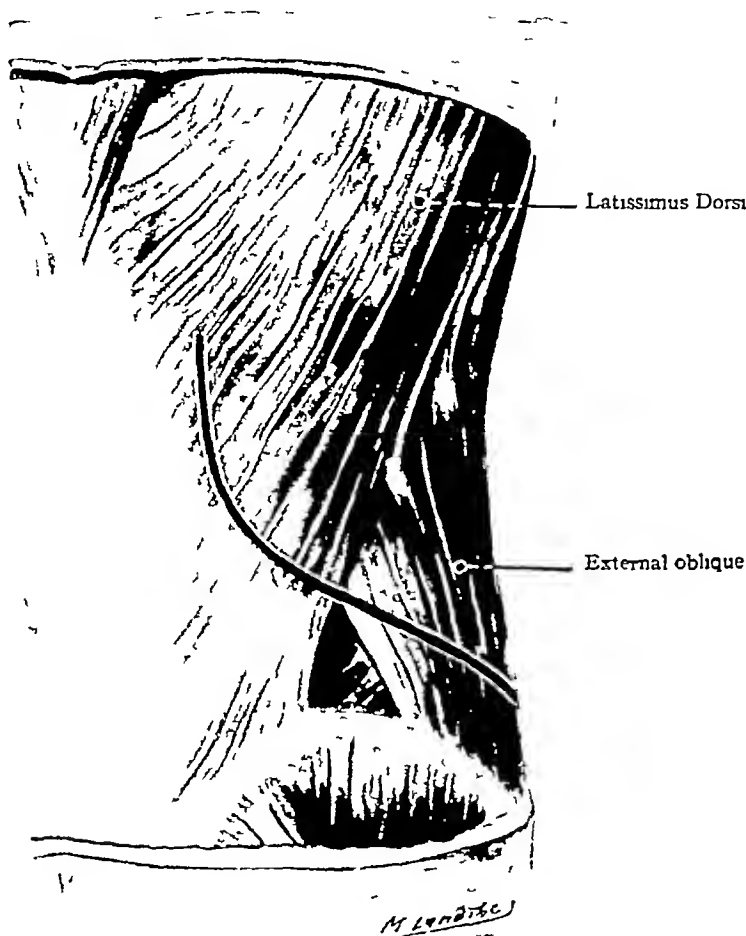


FIG 681—First layer of muscles to be divided in lumbar approach to kidney. The incision begins at the angle between the last rib and the erector spinae muscles passing at first vertically downwards and then curves forwards dividing the latissimus dorsi and external oblique muscles almost at right angles to their fibers.

of the two layers of the lumbar fascia which form a sheath for the sacrospinalis (erector spinae) muscle.

(B) **QUADRATUS LUMBORUM** A flat muscle separated from the sacrospinalis by a strong leaf of the lumbar fascia. Its strongest portion is near its points of attachment to the transverse processes of the first and second lumbar vertebrae and lower edge of the twelfth rib. The lateral border of the muscle is free and rests upon the transversalis muscle and its fascia. Under normal conditions, the kidney extends 1-3 cm lateral to this free edge, hence it is seldom necessary to divide the quadratus in order to expose the kidney. The relation of the twelfth intercostal and first lumbar nerves to this muscle will be taken up later.

(C) **PSOAS MAJOR** This lies so deeply as to rarely come into consideration in kidney operations.

BLOOD VESSELS AND NERVES OF THE ILOCOSTAL SPACE

The last intercostals, the subcostals (or twelfth) and the upper lumbar arteries and veins supply the muscles and overlying integument. Of these the subcostals are the most important but are seldom divided unless it is necessary to enlarge the incision toward the region of the ligamentum costolumbale (costo-transverse) where one is apt to encounter the ventral or larger of the two main branches of the artery which runs parallel to and below the twelfth rib.

The veins accompany the arteries throughout the region. We shall refer to the lumbar veins later.

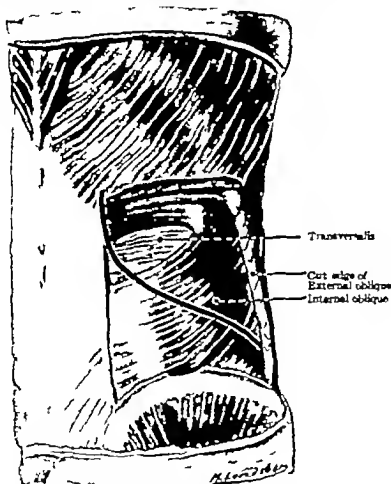


FIG. 682.—Second layer showing relation of incision in lumbar approach to kidney to division of internal oblique muscle.

Nerves of the Iliocostal Space (Renal Region) The skin is supplied by the cutaneous twigs of the tenth and eleventh thoracic nerves. There are but two nerves of surgical importance, viz., the twelfth thoracic and first lumbar. (See Fig. 684.) The ventral division of the former runs parallel to the last rib, pierces the oblique abdominal muscles and ends in the rectus. The ventral branches of the first lumbar are the iliohypogastric and inguinal. They extend on the ventral (inner) side of the lumbar fascia to a point 2.5 cm. lateral to the quadratus lumborum and then separate. The iliohypogastric remains between the transversalis muscle and internal oblique, perforating the latter to reach the integument of the pubic region. The ilioinguinal perforates the transversalis further anteriorly and ends in the integument of the inguinal region.

There is considerable variation in the mode of division of the first lumbar nerve. When the two branches run close together, parallel to and close to the iliac

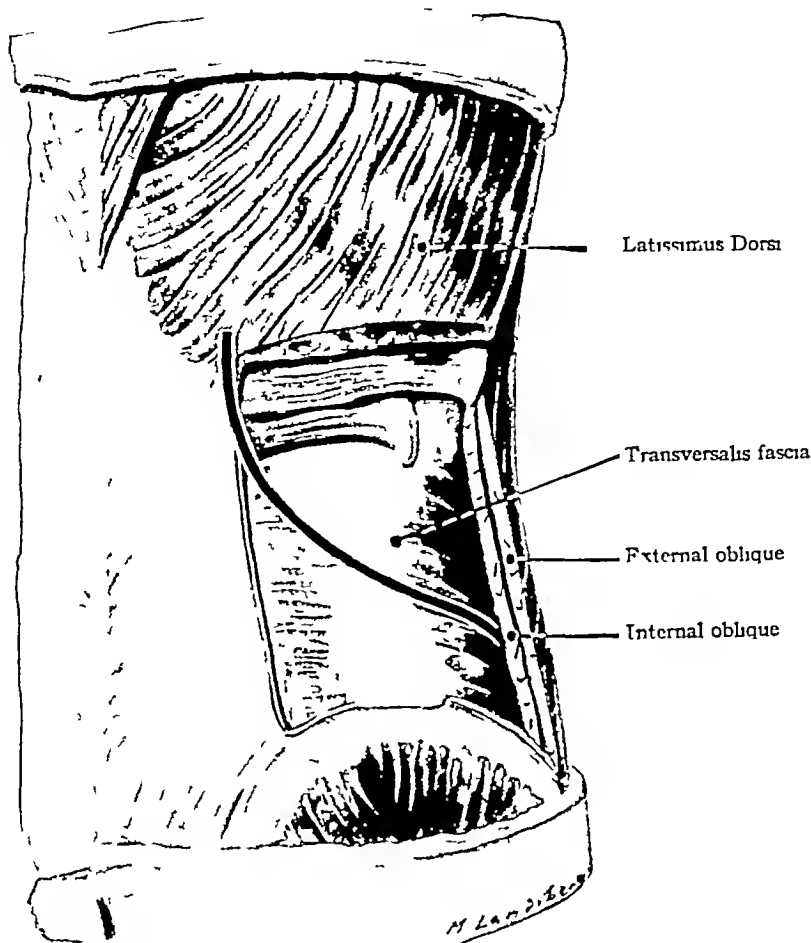


FIG 683—Third layer showing relation of incision for lumbar approach to kidney, to the transversalis fascia and muscle

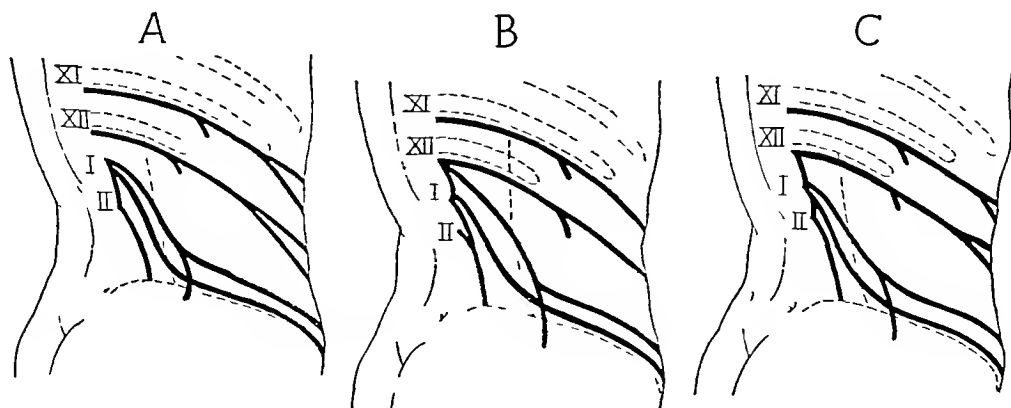


FIG 684—Variations in distribution of the last thoracic and the first two lumbar nerves (After Max Broedel) If the incision is made midway between the last rib and crest of the ilium, it is possible to avoid division of the ilioinguinal and iliohypogastric nerves as shown in A and C, which represent most common mode of division of the first lumbar nerve

crest (A and C of Fig 684), one can incise the abdominal muscles without sacrificing any of the main branches but when they cross the operative field almost at

right angles, (B of Fig 684) It is difficult to secure adequate exposure without sacrificing one of them

RELATIONS OF THE KIDNEYS TO ADJACENT STRUCTURES

A Posterior relations, i.e., to abdominal muscles diaphragm ribs and pleura.

(A) **BELOW THE TWELFTH RIB**
The kidney does not come in contact directly with any of the surrounding structures being separated behind by the peri and paranephric fat and the retrorenal fascia which form a cushion or bed for it. This being understood we can speak of the posterior surface of the kidney as lying in contact below the twelfth rib with the quadratus lumborum muscle overlapping it mesially to lie to a lesser extent on the psoas muscle. This posterior (dorsal) surface of the kidney extends laterally beyond the quadratus to rest upon the transversalis muscle and its fascia (middle leaf of lumbar).

(B) **ABOVE THE TWELFTH RIB**
Separated only by the perinephric fat and the retrorenal fascia the diaphragm comes in direct contact with the posterior surface of the kidney thus bringing it into close relation with the pleural reflection and costophrenic sinus. (Fig 685) This relation is of much importance in operations on the kidney

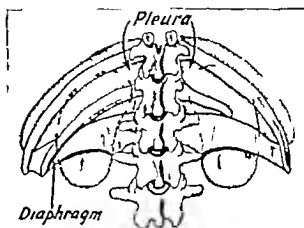


FIG 685—Relation of kidneys to diaphragm, pleurae and last two ribs. On the left side of the illustration is shown how a long twelfth rib lies partly (proximal half) in relation to the pleural reflection. Its outer (distal) half is in close contact with the diaphragm. On the right side of the illustration is shown a short twelfth rib whose entire anterior aspect lies in close contact with the pleural reflection the latter as on the opposite side of the body passing beneath the proximal half of the rib. This relation is of the utmost importance to bear in mind in order to prevent injury of the pleura during kidney operations. (See Chapter 36)

WHEN THE TWELFTH RIB IS SHORT (Fig 686) the pleural reflection extends below it so that the entire rib lies in contact with the reflection and the costophrenic sinus. When the twelfth rib is long only the mesial (proximal) half is in contact (Fig 685) with the pleural reflection the latter passing almost horizontally toward the axillary region.

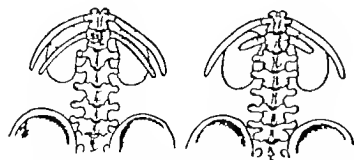


FIG. 686—Long and short twelfth rib. The relation of these to the pleural reflection is shown in Fig. 19

Formerly it was the custom to resect the twelfth rib when the iliocostal space was too narrow and the rib immobile in order to secure better operative exposure in kidney operations. Opening of the pleural reflection was not uncommon even though a costectomy was performed. At present we are able by division of the arcuate or costotransverse ligament as suggested by W. J. Mayo, to amply mobilize (Fig 694) a long twelfth rib without resection.

THE DIAPHRAGM BEHIND THE KIDNEY is very thin and offers but little resistance to infection from below or above. In addition there is a gap in many individuals allowing pus to invade the pleural cavity without an actual perforation of the diaphragm. Infection in a downward direction i.e. from an empyema to the perinephric tissues is rare, but this is not true of infection extending toward the pleura, hence this anatomical relation must be constantly kept in mind in cases of severe renal infection.

B Anterior Relations, i.e., to Peritoneum, etc. These differ somewhat on the two sides, as follows

FIG 687

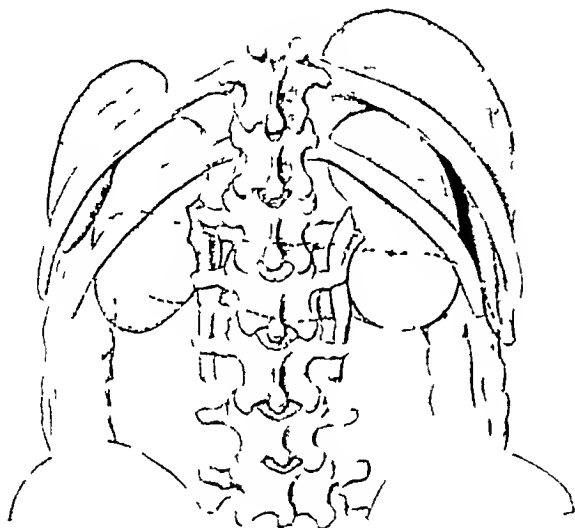


FIG 687—Relations of the kidneys to the spleen, colon and right lobe of the liver, as seen from behind (After Corning)

FIG 688

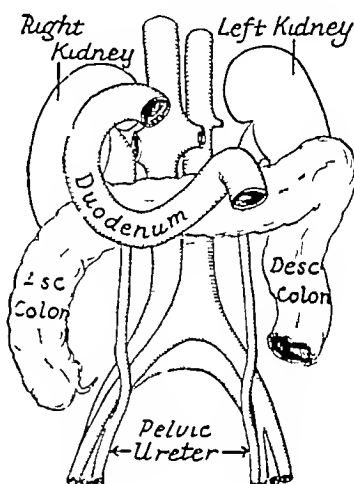


FIG 688—Relations of kidneys to more important structures in front. Note how duodenum (see also Fig 23) lies in close contact with right kidney, also the relations between the hepatic and splenic flexures respectively to the lower poles of the kidney

(A) ON THE RIGHT SIDE (Fig 687) Here the kidney (of course separated by the prerenal fascia and parietal peritoneum) is in contact with the right lobe of the liver, the duodenum and hepatic flexure of the colon. The relation of the duodenum is of importance because it is exposed during kidney operations and overlaps the right kidney to a variable extent (see Figs 688 and 700)

Enough cases of injury to the duodenum with fistula formation have been reported to justify keeping this relation of the duodenum to the anterior surface of the right kidney constantly in mind, in applying clamps to or ligating a renal pedicle. The relations of the ascending colon and especially of its hepatic flexure are also of clinical interest. The peritoneal reflection is in close contact with the prerenal leaf of renal fascia and hence the ascending colon must be displaced mesially (inwards), in order to expose the kidney adequately. The hepatic flexure lies in contact with the anterior surface of the lower pole of the normally located right kidney but in cases of abnormally mobile kidney this relation may be greatly altered.

On account of the relation of the ascending colon and its hepatic flexure to the right kidney it is not difficult to visualize how a retrocecal appendiceal abscess (see Chap 40) may develop in close relation to the lower pole of the kidney and

simulate a perinephric abscess and vice versa how the latter when developing at the lower pole of the kidney, may simulate a retrocecal appendicitis.

(B) ON THE LEFT SIDE (Figs. 687 and 688) Here the kidney is in relation to the tail of the pancreas spleen splenic flexure and descending colon. These are of interest chiefly because of the following clinical possibilities

PERITONEAL REFLECTION

We have already directed attention to the relations of the intraperitoneal viscera to the kidneys. Of these the ascending and descending portions of the colon (Fig. 688) play an important part in operative exposure of the kidney and upper ureter. It is essential to have a knowledge of the fact that the parietal peritoneum is reflected very close to the outer border of the kidney on both sides. This is best seen in a cross section at the level of the middle of the kidney. One of the first steps in mobilizing the kidney (after division of the abdominal wall retrorenal fascia and perirenal fat) is to displace anteriorly this peritoneal reflection and the corresponding portion of the colon to avoid opening the reflection and peritoneal cavity.

THE BLOOD VESSELS OF THE KIDNEY

The normal distribution of the arteries and veins is taken up in Chapter 2 that of anomalies in the blood supply so far as the main arteries and veins are concerned in Chapter 34. The anomalies of the retroperic vessels are discussed later in this chapter.

OPERATIONS ON THE KIDNEYS

GENERAL CONSIDERATIONS

These operations have certain points in common as follows:

- (a) The preparation of the operative field.
- (b) The position of the patient.
- (c) The incision through the various structures of the lateral abdominal wall.
- (d) The mobilization of the kidney itself.

Let us consider these four points briefly before taking up the technic of the individual operations in detail.

(A) The Preparation of the Field and (B) the Position of the Patient

It is advisable to prepare a field extending from the level of the angle of the scapula to that of the trochanter (greater) in a vertical and from beyond the median line in front to a similar point behind in a horizontal direction. The solution which is employed varies with the individual hospital. We prefer full strength tincture of iodine (7 per cent) diluted with equal parts of alcohol making it a 3.5 per cent solution or 2 per cent mercurochrome in acetone.

As a rule the patient should be placed in as nearly lateral a position as possible with the ilio-costal space (B of Fig. 689) widened as much as possible with the aid of a special elevator now attached to every modern operating table. In some individuals with long twelfth ribs (Fig. 68C) especially if there is much adipose tissue or well developed muscles every inch gained in this manner is an

advantage With the exception of the paraperitoneal incision (which we recommend for preliminary ligation of the pedicle in renal tumors and for exposure of the horseshoe kidney), and the incision for transperitoneal nephrectomy, this lateral position is employed in all of our cases

(C) **Incision of the Abdominal Wall** We prefer the W J Mayo modification of the Israel incision Its extent is usually lightly outlined (Fig 689) with a scalpel before division of the wall itself The incision begins at the angle¹ of junction of the vertebral end of the last rib and lateral border of the erector spinae muscle (B of Fig 689), extends almost vertically downwards to a point

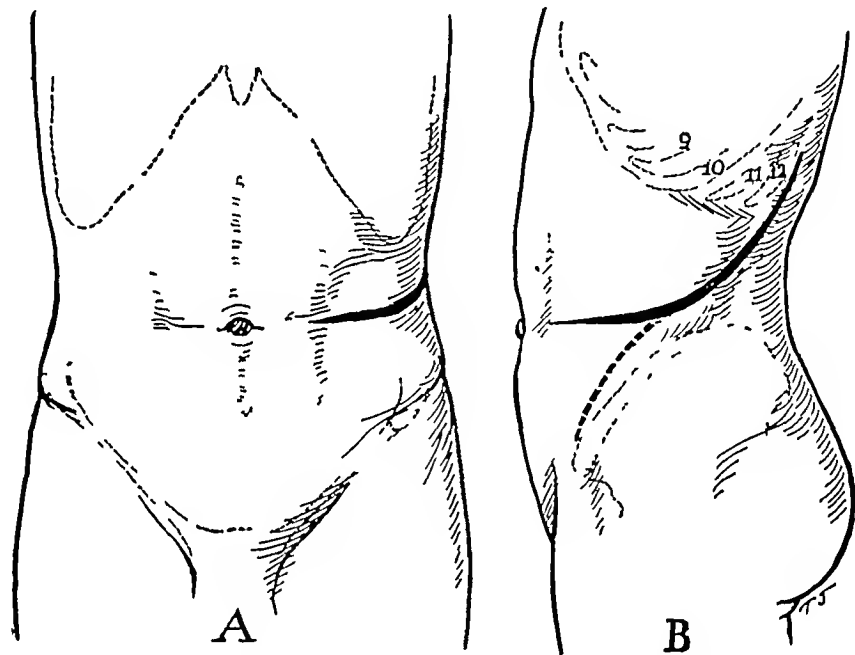


FIG 689—A This shows an extension forwards of the usual lumbar kidney incision, and is employed in cases in which one wishes to do a preliminary ligation of the renal vessels for a neoplasm (see Fig 685)

B The upper two thirds of the heavy line indicates course of usual lumbar kidney incision Instead, however, of extending transversely inwards as shown in A, the usual lumbar kidney incision curves downwards (as indicated by dotted portion) toward anterior superior spine of ilium

midway between the last rib and crest of the ilium, and after making a gradual turn anteriorly, continues² at this level to a point about one inch (2.5 cm) above the corresponding anterior superior point of the ilium

After division of the skin, and underlying adipose tissue, we divide the latissimus dorsi in the posterior and the external oblique in the anterior half (Fig 681) of the incision The second layer to be divided is the internal oblique muscle (Fig 682), which lies immediately beneath the external oblique As soon as this is carried out, one sees in the anterior half of the incision, a muscle whose fibers are parallel with that portion of our skin incision which runs midway between the last rib and crest of the ilium This muscle is the transversalis abdominis (Fig 683) and varies greatly in development in this (lateral) portion of the abdominal wall It ends rather abruptly in a firm whitish layer, the transversalis fascia (which is in reality the middle leaf of the lumbar fascia) When

¹ This is referred to briefly, as the costovertebral angle

² This enables one to usually avoid division of the last intercostal and first lumbar nerves (Fig 684)

this structure (transversalis fascia) has been divided, one knows that the pararenal (Fig 690) fat lies immediately beneath. As soon as this fascial layer (Fig 690) is divided in a horizontal direction the pararenal fat pushes its way into the field (Fig 690) and one is ready to begin the next step of the operation viz. mobilization of the kidney.

THE ONLY CASES IN WHICH WE DO NOT FOLLOW THE ABOVE TECHNIC are the following

1 WHEN ONE WISHES TO EXPOSE THE RENAL PEDICLE FIRST for the purpose of ligating the pedicle before the kidney is mobilized. This is our routine at present in neoplasms of the kidney provided the size of the tumor permits access to the pedicle first.

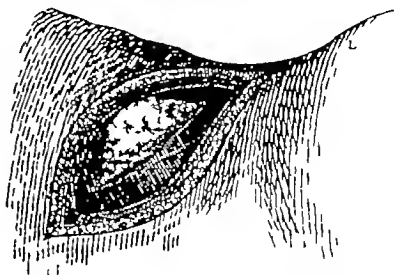


FIG 690—The transversalis fascia has been incised and the pararenal fat now presents.

2 WHEN ONE DESIRES

TO EXPOSE ONE OF THE HALVES OF A HORSESHOE KIDNEY or one in which an anomaly such as lumbar or iliac (ordinary) ectopia, or as crossed ectopia is present. These were described in Chapter 32. In case either of the above two indications exists we begin with the ordinary lumbar incision (B of Fig 689) just described the patient being in direct lateral position. The kidney is first exposed but no attempt is made to mobilize it.

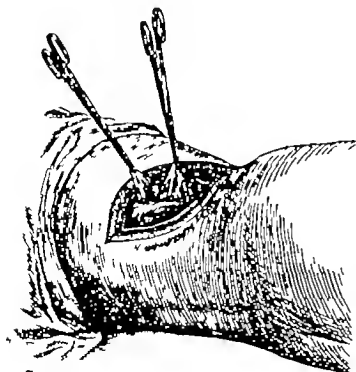


FIG. 691—The peritoneal fold in front of the kidney is pulled up so as to show its attachment along the anterior surface of kidney and the necessity of displacing the peritoneum forwards in mobilization of the kidney.

rectus muscle. The muscular layers of the abdominal wall (external internal

The incision through the skin in these cases instead of gradually approaching (B of Fig 689) the anterior superior spine of the ilium is continued transversely forwards (A of Fig 689) to the outer border of the corresponding

oblique and transversalis) are divided in a direction parallel to that of the skin incision, as far anteriorly as the outer border of the rectus. By displacing the peritoneum (Fig 722) forwards, one can secure an excellent exposure in the class

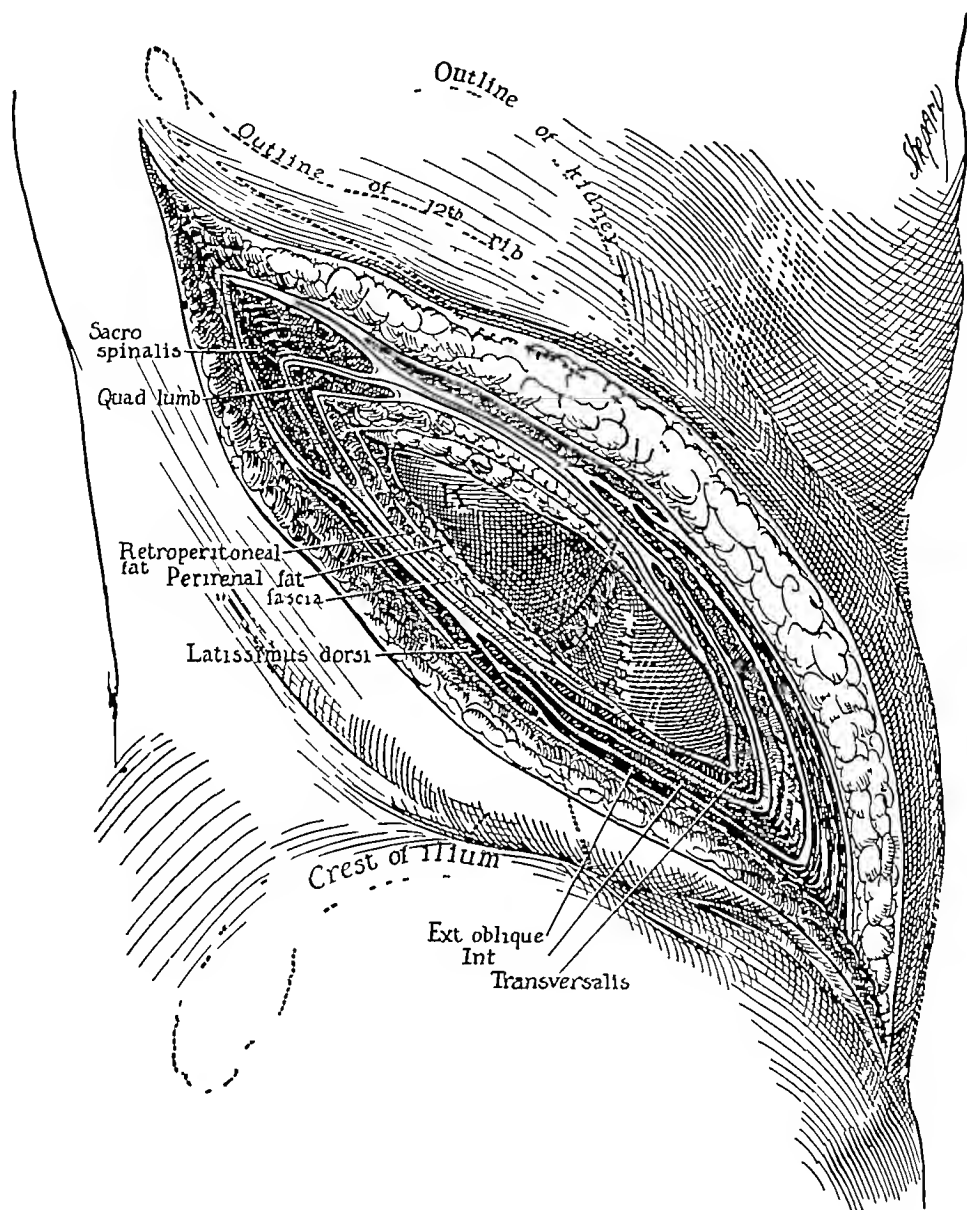


FIG 692—Relation of muscles and of peritoneal reflection to kidney

The anterior half of the operative field shows the divided external oblique, internal oblique and transversalis. In the posterior half of the field of operation note the divided latissimus dorsi, quadratus lumborum and sacrospinalis (erector spinae) muscles. It is seldom necessary to divide the two last named muscles.

of cases, just mentioned, as suitable for this Bazy modification of the ordinary lumbar incision.

After the kidney has been amply exposed with the patient in direct lateral, we change to an almost dorsal position, while the incision is continued forwards to the outer border of the rectus muscle.

The technic of the incision for preliminary ligation of the renal vessels and for transperitoneal removal of the kidney, will be considered under nephrectomy.

(D) **Mobilization of the Kidney** After gentle separation of the para renal fat behind and lateral to the kidney we encounter (Fig 692) a thin fibrous structure the posterior leaf of the renal fascia (see Chap 2 on Anatomy and Fig 692) An incision is made into this and one encounters the true perinephric fat. This may be very easily separated as a rule with the fingers (Fig 691), until the kidney itself, is reached.

INFLAMMATORY THICKENING OF THE PERINEPHRIC FAT

We have already called attention³ to the conversion of this loose adipose into a mass of dense fibrous tissue under pathologic conditions and shall refer to it again in connection with subcapsular nephrectomy. When

such an inflammatory thickening of the perinephric fat is present or when the kidney is very large no attempt should be made to mobilize the kidney until the incision in the abdominal wall is ample, and two other steps to be described next, have been carried out.

THE FIRST OF THESE IS MOBILIZATION OF THE LAST (12TH) RIB. In many cases it is simply necessary to exert traction in an upward direction until this rib has been mobilized enough to greatly enlarge the size of the depth of the original incision. If this is impossible one can resort to one of two procedures (a) subperiosteal resection of the last rib or (b) division of the costotransverse ligament first described by Henle.

Before our attention was directed by W. J. Mayo to the ease with which the second of these procedures could be done we were compelled to resect or break the twelfth rib in a number of cases.

This costotransverse ligament stretches from the transverse processes of the first and second lumbar vertebrae in a fanlike (Fig 694) manner to the twelfth and eleventh rib.

It can be readily felt as a tense fibrous band at the vertebral end of the twelfth rib. It is quite easily divided and permits the twelfth rib (Fig 705) to be mobilized completely, greatly facilitating access to the upper two thirds and pedicle of the kidney when there is much fixation or a short pedicle.

Injury of the last intercostal artery and vein is almost unavoidable during



FIG. 693.—Mobilization of the kidney. The edges of the renal fat and fascia are grasped by forceps while one proceeds to separate the kidney on all sides from its enveloping fat and in front from the colon duodenum (on right side) and peritoneal fold (Fig. 659).

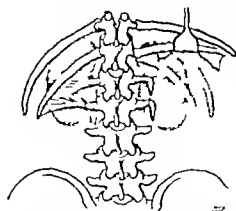


FIG. 694.—Method of division (shown on right side of illustration) of the costotransverse ligament in order to mobilize the twelfth rib (see text).

division of this costotransverse ligament, but the vessels can be easily reached and ligated, preferably by transfixion

One must be careful during this method of mobilization, as also during subperiosteal resection of the last rib, not to open the pleural reflection. This (Fig 687) passes well beneath the posterior half of a long twelfth rib, but can easily be recognized, if there is good hemostasis, by its pearly white appearance and movement during inspiration. Even if one accidentally opens the pleura, no harm will result if it is immediately sutured with fine chromic catgut, tied over a piece of fat to prevent its cutting through. In some cases, the pleural wound is so difficult to suture, that one must be content with closing the opening⁴ by gauze packing

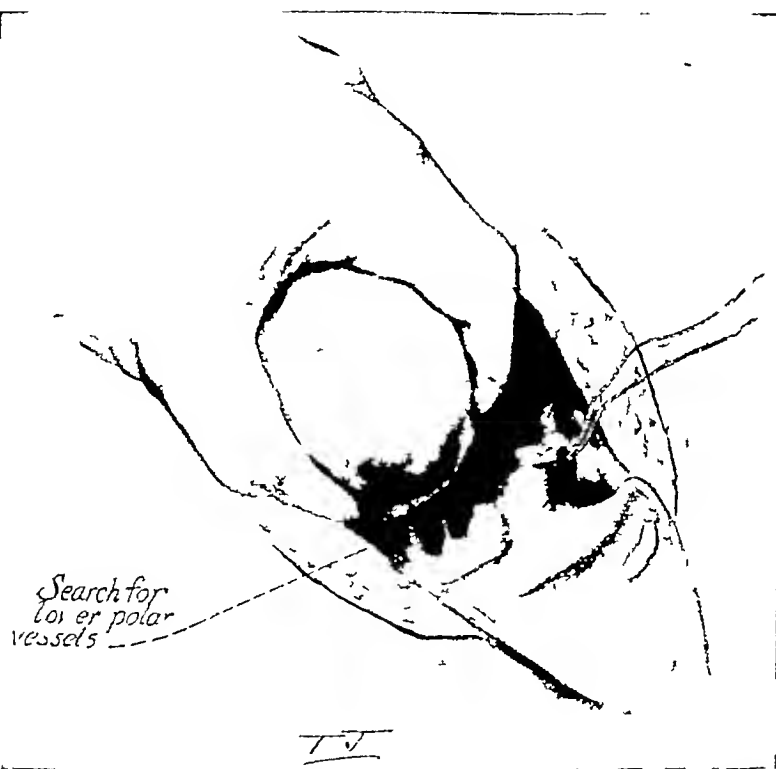


FIG 695—Search for lower polar vessels before ligation of pedicle in nephrectomy or better, before mobilization of the kidney. The lower pole is raised with one hand while the other palpates or inspects all strands, etc., running to lower pole from aorta or vena cava

There are few vessels of any size which one encounters in the ordinary lumbar incision and unless some marked anomaly (Fig 684) in the last intercostal and first lumbar nerves exists, even nerve injury is rare

DISPLACEMENT OF THE COLON Granted that the exposure is ample and the perinephritic fat has not undergone too much inflammatory change, we proceed with the mobilization of the kidney by gently displacing the colon (Fig 692) forwards and the duodenum⁵ forwards and upwards. If one understands the anatomic relations of the colon and duodenum (on the right side), to the anterior surface of the kidney, and the necessity of pushing them away, before any

⁴We have recently used fat pads to prevent sutures from cutting through on the principle of the Beer-Hagenbeck method (Fig 705)

⁵Attention was called at the beginning of this chapter to the relation of the duodenum to the right kidney and the danger of its being included in the clamp applied to the pedicle, on this side

attempt is made to bring the kidney into the wound in cases with many adhesions opening of the peritoneal cavity will seldom occur. The importance of such an accident, like that of opening the pleural cavity, has been greatly exaggerated and no harm will result, if the opening is immediately closed.

TRACTION IS NOW MADE UPON THE LOWER POLE until it has been completely freed care being taken to ascertain by palpation (Fig. 695) whether any inferior polar vessels are present. The separation of the kidney from the perinephritic fat is now continued until the upper pole can be easily delivered into the



FIG. 696.—Search for upper polar vessels before complete mobilization of kidney. I attempted. The lower polar vessels are first sought for (Fig. 695) and then the upper pole is retracted as shown here while one palpates for polar vessels.

abdominal incision. The same care should be exercised in an examination (Fig. 696) of the upper pole for accessory vessels as in the case of the lower pole.

Israel was the first to report a severe hemorrhage from a torn lower polar artery which had retracted and only began to bleed after the operation. The importance of a routine search for such accessory arteries and veins cannot be too strongly emphasized. Only a relatively short time is required to palpate the medial borders of the upper and lower poles for accessory vessels during delivery and freeing of the kidney from the surrounding fat. It is a good rule never to divide any firm bands of tissue which one has felt running to the upper and lower poles until they have been inspected.

The relation of such vessel to hydronephrosis is taken up in Chapters 34 and 36.

The kidney operations which are at present, most frequently employed, are

- 1 Pyelotomy
- 2 Nephrotomy
- 3 Decapsulation
- 4 Nephropexy
- 5 Resection of the kidney and heminephrectomy
- 6 Nephrectomy and nephroureterectomy

Let us consider these in the order just given

PYELOTOMY

This operation consists in opening the renal pelvis, in order to be able, usually, to remove calculi without damage to the parenchyma of the kidney, as described in Chapter 42 There are three types of the operation

- 1 Anterior pyelotomy in which the pelvis is opened on its more ventral (i.e. front) surface (Fig 24)

FIG 697

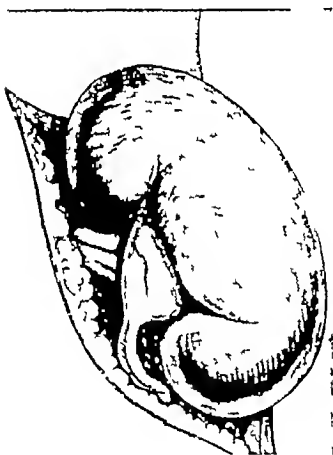


FIG 698

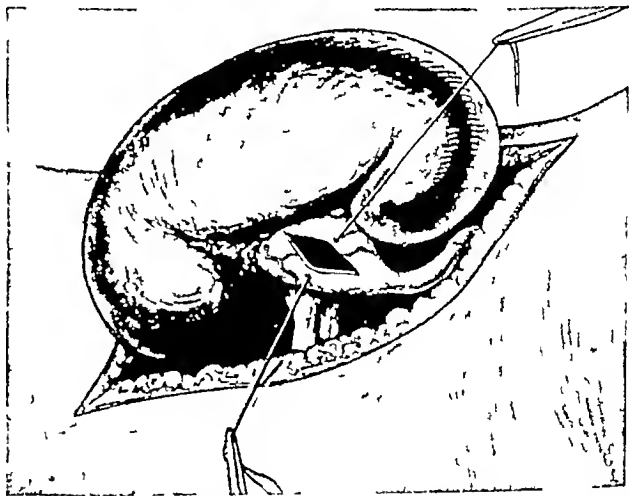


FIG 697—First step of technic of ordinary posterior pyelotomy The kidney has been drawn into abdominal incision, laid on its ventral surface and posterior aspect of the renal pelvis exposed Note avascularity of this surface

FIG 698—Second step of technic of ordinary posterior pyelotomy The two traction sutures of fine catgut have been inserted and the edges of the pyelotomy incision retracted

- 2 Posterior or ordinary pyelotomy in which the dorsal surface is opened (Figs 697 and 698)

3 Enlarged pyelotomy, a term first suggested by Marion to designate an operation by which the posterior lip of the hilum, is also divided, so as to increase the size of the pyelotomy opening Of these, the anterior type, is employed by only one urologist, Illyes of Budapest, so far as we know The enlarged type of pyelotomy is only indicated under certain special conditions to be named, so that the operation of choice today, is by the posterior route, hence when pyelotomy is spoken of, this method is usually understood Because it is most often employed for the removal of calculi, the term pelviolithotomy, is applied, by a few urologists, in such cases

Technic of Anterior and Posterior Pyelotomy

The kidney after being completely mobilized in the manner described above,

is delivered into the abdominal incision as near its most superficial layer, as possible. In the anterior operation the renal pelvis is exposed by retracting the vessels of the pedicle. The danger of injury to the latter which enter the renal sinus by passing across the anterior aspect of the pelvis (see Fig 24 in Chap 2), is the chief reason why this method of approach has never been more widely adopted.

In posterior (ordinary) pyelotomy we have the advantage of making the incision into the renal pelvis through an anastomosis, which is avascular in the majority of individuals. With the exception of the anomalies to be mentioned later the only vessel of any size is the retroperitoneal artery which we have seen (Fig 28 of Chap 2) arises from the main renal and passes into the kidney after forming an arch (Fig 702) beneath the posterior lip of the hilum i.e. well away from the incision (Fig 698) ordinarily required for a pyelotomy.

We have found that if gentle traction is made upon the renal pedicle and an assistant is instructed to place one hand beneath the anterior and the other over the posterior aspect of the kidney, and the latter is turned well upon its face (anterior aspect) that difficulty is seldom met with in securing a good exposure of the posterior surface of the renal pelvis.



FIG. 699.—Forceps with hollow blades for removal of renal or ureteral calculi.

There is a layer of fat to be separated before the bluish color of the fibrous outer wall of the pelvis itself is visible. We prefer to push aside this peripelvic fat with a blunt pointed curved scissors rather than to divide it with a scalpel. As soon as the pelvis itself (Fig 665) is recognized we insert two temporary traction sutures of catgut between which the incision through the wall of the renal pelvis (Fig 698) is made. Only the smallest size catgut (00 or 000) and correspondingly small needles are employed for the traction sutures. For opening the pelvis a scalpel much smaller than that used for the abdominal incision, is advisable.

If a calculus can be felt in the renal pelvis immediately upon exposure of its posterior aspect, one can make an incision directly upon the calculus and deliver it with the aid of a special stone forceps (Fig 699). If however the calculus is not so accessible we suggest the use of the traction sutures and bimanual examination. (Fig 668.)

Closure. The majority of urologists prefer not to close the pyelotomy incision. We follow this method, except in cases where the incision is a relatively large one or it has been necessary to approach very close to the beginning of the ureter (Fig 698). Under these conditions it is better to close most or all of the pyelotomy incision with fine plain (00) catgut interrupted sutures care being exercised not to penetrate the epithelial lining of the renal pelvis. Suture of the peripelvic fat alone does not suffice and we find it can be dispensed with if

the edges of the incision into the pelvis proper, have been accurately brought together

DRAINAGE Before closing the pyelotomy incision or preparing to drain it, it is advisable to pass a ureteral bougie or catheter of fairly large size (7-8 F), in a retrograde manner, so as to exclude any shadowless or overlooked ureteral calculi or a stricture, which might need postoperative dilatation. We shall refer shortly to fistula following pyelotomy. This can often be avoided if such a bougie or catheter is passed downwards into the ureteral lumen as far as the bladder, from the pyelotomy incision. In a similar manner, we often utilize the opening in the renal pelvis to insert a stone forceps (Fig 699) in order to search for or remove calculi lying in the

FIG 700

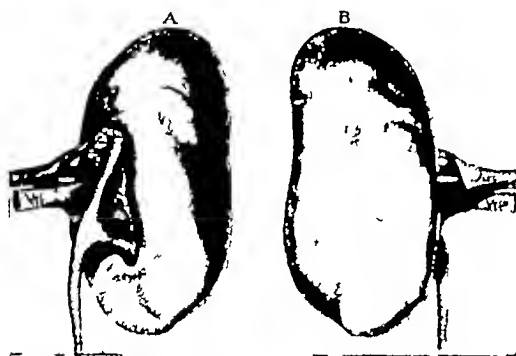


FIG 700—Autopsy specimen of non-rotated kidney (minor degree)

A Anterior aspect showing faulty development of anterior lip of hilum and vessels passing behind

B Posterior surface. No portion of pelvis visible

FIG 701

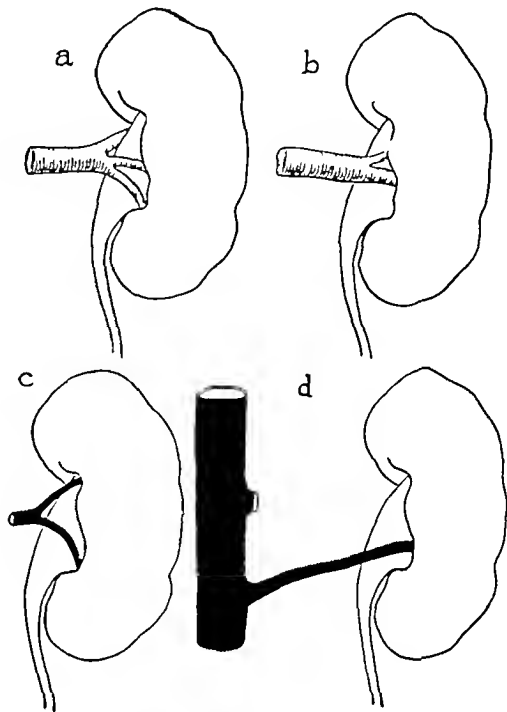


FIG 701—Anomalies of the retropericeliac vessels of importance in posterior pyelotomy
A and C The retropericeliac artery and vein, respectively, pass across the posterior surface of the renal pelvis

B The main renal artery or a very large branch, passes across the posterior aspect of renal pelvis

D Same true of renal vein

calices of an ampullary type of pelvis (Fig 20) or in one of the two branches of a bifid pelvis (Fig 21)

DRAINAGE AFTER PYELOTOMY IS INDISPENSABLE and is best carried out by anchoring the proximal end of the rubber tube to the peripelvic fat close to the pyelotomy incision, using plain catgut as suture material, so that the tube can be easily removed at the end of 10 days

DIFFICULTIES ENCOUNTERED IN ORDINARY (POSTERIOR) PYELOTOMY

1 **FAULTY ROTATION OF THE KIDNEY** Usually the diagnosis of incomplete or excessive rotation (Fig 424) of the kidney (see Chap 32) can be made by an inspection of the pyelogram (Fig 425). If, however, the operator is not aware of the possibility of such a congenital anomaly, a prolonged search will be unavoidable, before the renal pelvis is found (see Fig 700)

2 **EXTERNAL VERSUS INTRARENAL PELVIS** In Chap 2 on Anatomy attention has been called to the occurrence of variations in the extent to which the renal

pelvis lies within the renal sinus (Fig 22) and how much lies outside of the kidney proper. A knowledge of these anatomic variations will avoid much trouble. The simplest pyelotomies are those in which there is an ample extrarenal portion (Fig 697) of the pelvis. If the pelvis is almost entirely within the renal sinus, i.e. is intrarenal, the ordinary pyelotomy will often be impossible and one must resort to the enlarged pyelotomy method (see later).

3 ANOMALIES OF THE RETROPELVIC VESSELS Instead of a single artery which enters the kidney in such a manner, as to leave practically all of the posterior aspect of the renal vessels free of blood vessels of any but negligible size a number of possible vascular anomalies occur.

(a) The renal artery or vein divides into an equal number of pre- or retro-pelvic branches the latter forming a fan like network over the posterior aspect of the renal pelvis (see a and c of Fig 700)

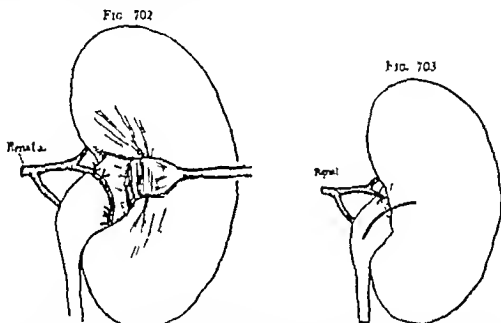


FIG. 702.—Enlarged pyelotomy. The hilum is retracted and retro-pelvic artery is shown before division between two ligatures. Note additional exposure of posterior aspect of renal pelvis.

FIG. 703.—Enlarged pyelotomy. The retro-pelvic artery (see Fig 61) has been divided between two ligatures. The solid dark line indicates the extent of an ordinary posterior pyelotomy incision. The dotted lines indicate the various directions in which the ordinary posterior pyelotomy incision can be extended through the pelvic wall after retraction of the posterior lip of hilum (see Fig 61).

(b) The retro-pelvic artery may pass obliquely across the posterior aspect of the renal pelvis instead of forming an arch beneath the posterior lip of the hilum (a of Fig 702).

(c) The main renal artery or vein (b and d of Fig 701) may enter the kidney by passing across the back instead of the front of the renal pelvis (Fig 24).

4 VARIATIONS IN LENGTH OF THE RENAL PELVIS. Thus as we have seen (Chap 2) is as a rule about 2.5 cm. shorter on the right side. Cases are encountered, however, on both sides of the body in which it is very difficult to draw the kidney into the wound sufficiently to enable a satisfactory exposure. An incision into the renal pelvis to be made. We do not advise attempting to perform a pyelotomy by palpation alone. A few urologists of large experience do make an effort to bring the kidney into the wound but for the average

operator, this is a hazardous procedure because of the vascular anomalies just referred to

5 PERIPYELITIS In some cases, there has been such an extensive infection of the fat around both the extra and intrarenal portions of the renal pelvis, that it is very difficult to identify the wall of the pelvis proper. In such cases, it is of much assistance to either isolate the uppermost portion of the ureter, and follow it upwards, or to abandon the attempt to perform a pyelotomy, and substitute a nephrotomy.

Enlarged Pyelotomy

This only differs from the ordinary pyelotomy in the fact that the posterior lip of the hilum of the kidney is divided. Marion pays no attention to the small retropelvic artery and does not attempt to search for it. We find, however, that this is very simple, if a fine retractor is employed to lift up the posterior lip. One

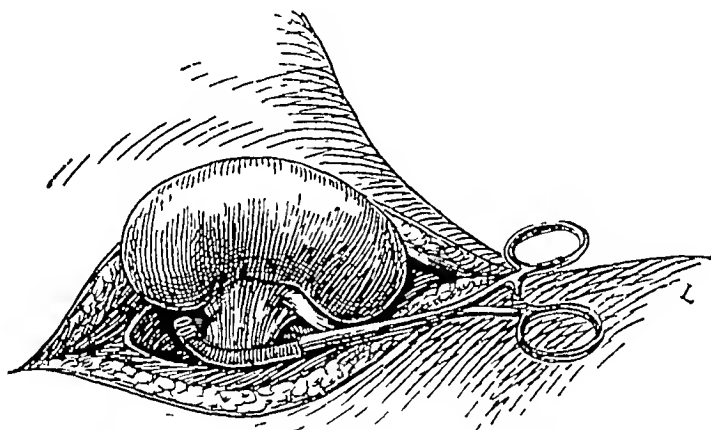


FIG 704—Method of temporary hemostasis during kidney operation. The blades of a special curved forceps are covered with rubber tubing. Care should be exercised not to close the blades too tightly and the ureter must never be included. A safer method is shown in Fig 712.

can readily identify and ligate the retropelvic artery (Fig 701), before extending the pyelotomy incision toward the renal sinus (Fig 703). This operation enables one to remove relatively large calculi, and to explore the pelvis proper and its calices, in a far more satisfactory manner than with the ordinary pyelotomy incision. With increasing experience, one learns to limit the use of the enlarged pyelotomy method to comparatively few cases. Although as Broedel has shown, the retropelvic artery supplies a portion of the posterior half of the kidney, its division has never been followed by necrosis, in our experience.

NEPHROLITHOTOMY

Nephrotomy is most frequently employed for the removal of calculus, hence the term commonly applied to an incision through the cortex alone, in the case of calculi in dilated calices or through both cortex and medulla for more deeply located calculi, is nephrolithotomy. The progress made during the past 25 years in the localization of calculi in the kidney has made obsolete such an operation as bisection through the Broedel line. In general, nephrolithotomy has ceded its place as operation of choice, to pyelolithotomy, i.e. removal of calculi through a pyelotomy incision. The tendency is to make the nephrolithotomy incisions as

small as possible because they are easier to close and there is less danger of postoperative bleeding

Hemorrhage during or immediately after nephrolithotomy can be controlled in one of three ways

1 By having an assistant compress the pedicle between the index finger and thumb This is not very satisfactory because with the best of intentions, such a compression is of only short duration

2 By grasping the pedicle with rubber-covered clamps (Fig 704) This is a dangerous method unless constantly controlled by the operator so that the blades are not too closely approximated otherwise there is danger of injury to the vessels Wesson has reported a case in which the circulation was completely cut off resulting in expulsion of the kidney from the wound during the postoperative course as a sequestrum The forceps must never be locked the assistant being shown by the operator himself that complete hemostasis can be secured by lightly approximating the blades

3 We prefer an ordinary small (14 F) soft rubber catheter placed like a tourniquet (Fig 712) around the pedicle and a forceps placed at the point where the two ends of the catheter cross so as to prevent them from slipping

Hemorrhage following nephrolithotomy can be prevented in one of three ways

1) By the Beer Hagenbach method as explained in Fig 705 We prefer plain catgut as suture material and have never observed postoperative bleeding even in extensive resections of the kidney The danger of necrosis which has been one of the criticisms of this method is negligible

2) Placing pads of fat between the parenchyma edges as suggested by Koll or muscle as suggested by others to act as hemostatics and then suturing the capsule over the fat or muscle

3) Using the ribbon gut method of Lowsley (Surg Gyn and Obst 1933 57 494) The capsule is incised and the ribbon gut slipped in so as to lie in the subcapsular space and tied so as to approximate the edges of the nephrotomy incision.

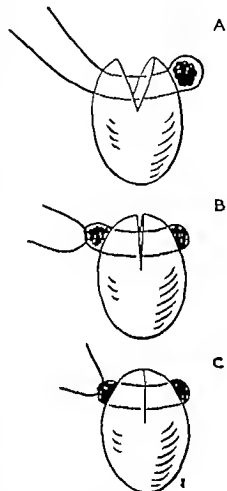


FIG. 705—Beer Hagenbach method of hemostasis for kidney incisions or wounds.

A A mattress suture is inserted deeply and a pad of fat or muscle placed beneath loop on distal side

B A similar pad is placed beneath the knot before being tied.

C Appearance after tying the knot.

NEPHROSTOMY

Drainage of the kidney for prolonged periods is best accomplished by making an incision (Fig 706) over the posterior aspect of the renal pelvis and a counter incision into the pelvis through the convexity so that a Malecot type (middle one of Fig 69) can be introduced into the pelvis There are two methods in current use

1 **The Papin Method** (Fig 706) Through an incision in the renal pelvis a long bladed slightly curved forceps is passed through the parenchyma to a point on the convexity. An incision is then made over the end of the forceps, whose blades are spread sufficiently to enable a Malecot catheter to be pulled through into the pelvis.

2 **The Cabot Method** (Fig 707) A uterine sound bent into a more or less U-shape is passed into an opening in the pelvis, and pushed outward until it encounters the capsule of the kidney. A short incision is made over the point of the sound, to whose blunt end a stout thread is attached. The sound and thread

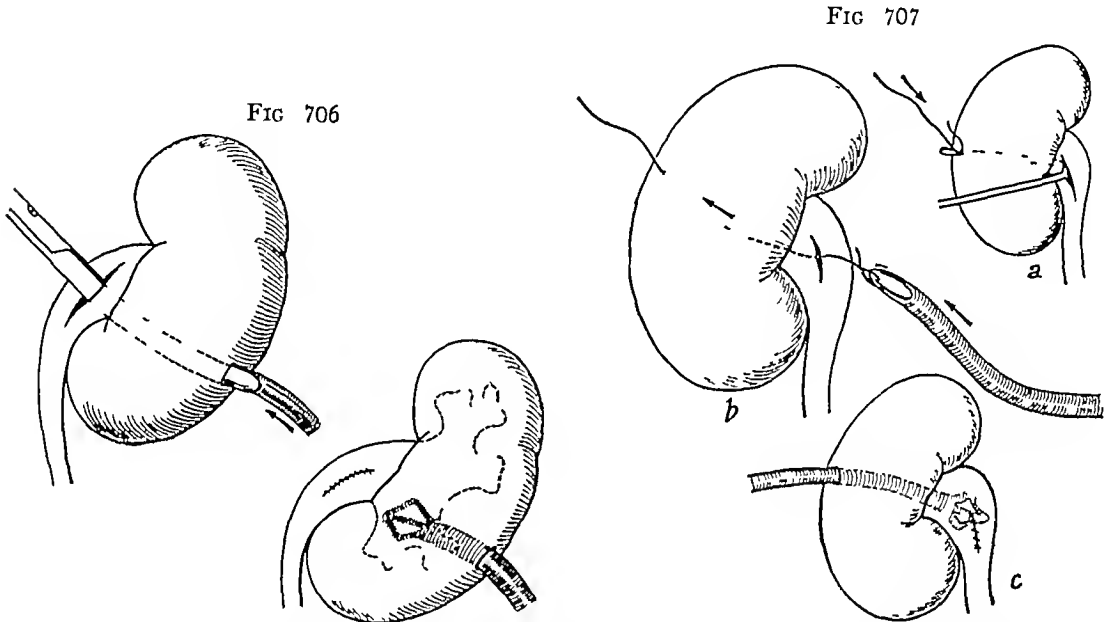


FIG 706—Papin technic for nephrostomy. Clamp introduced through the pyelotomy incision and through the renal parenchyma grasping a Malecot type of rubber catheter (left upper drawing). The pyelotomy incision is closed leaving the self-retaining Malecot catheter in place in lower calyx (right lower drawing). (Courtesy of Dr E Papin)

FIG 707—Cabot technic for nephrostomy. a Uterine sound inserted through pyelotomy incision perforating the parenchyma and capsule, heavy silk ligature attached to sound. b Sound removed and Pezzar catheter tied to the ligature ready to be pulled through incision in renal pelvis. c Pezzar self-retaining rubber catheter in place in kidney pelvis. (Courtesy of Dr E Papin)

are then drawn out through the opening in the pelvis and a Malecot catheter is attached to the thread so that the catheter can be pulled through the opening on the convexity. Care must be taken so that the portion of the catheter between the kidney and skin incision does not become kinked.

These two methods are to be preferred if prolonged drainage is desired.

NEPHROPEXY

The indications for this operation were discussed in Chapter 35. Certain preliminary steps should always be carried out before the nephropexy, i.e., fixation of the kidney, is attempted. These preliminary steps include a search for polar vessels which may have compressed the ureter, after the kidney dropped, mobilization of the ureter (ureterolysis) and kidney (nephrolysis) by sharp division of any adhesions and inspection of the renal pelvis as to whether the ureter is strictured with resultant hydronephrosis. Many failures following nephropexy are due to overlooking one or more of these conditions.

There are many types of nephropexy which fall into three groups

1 Those which utilize the fibrous capsule alone (Fig 709)

2 Those which utilize the renal parenchyma by means of transfixion sutures (Figs. 710 and 711)

3 Those which utilize the last rib adjacent muscles, etc.

Group 1 Utilization of Fibrous Capsule Alone

A method which is frequently employed is shown in Fig 709. The capsule is divided into four equal parts into each of which a long chromic gut (size 0 or 1) suture is inserted and tied. A niche or bed for the kidney is now found as high as possible. The sutures through the two upper flaps are placed on fairly large cutting needles and passed through the last intercostal space and tied so as to lie subcutaneously. To prevent the suture from cutting through after the kidney has been pulled into



FIG. 68.—Patient with nephrostomy tube emerging through skin incision. The operation was performed under infiltration anesthesia through a muscle splitting incision.

new bed, the two sutures are tied over a piece of fat. The lower two sutures are inserted into the muscles of the abdominal incision and in addition some of the perirenal fat is used as a pad or support for the lower pole of the kidney. A patient upon whom a nephropexy has been performed ought to be kept in bed for three weeks. We have had a number of very satisfactory end results in using the above capsular method.

Group 2. Use of Transfixion Sutures (Figs 710 and 711)

This method has been extensively employed by Papin. Double catgut sutures are passed through the upper and lower poles respectively of the kidney. The ends are tied on the surface of the kidney, over a piece of fat, so as to prevent cutting through, thus leaving two free threads on

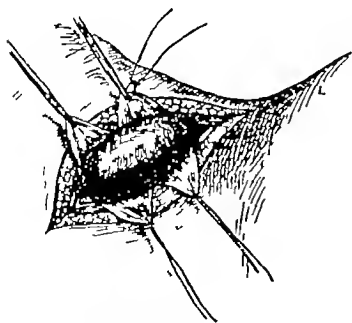


FIG. 709.—Method of utilizing the reflected true capsule of the kidney in nephropexy (see text)

the anterior and posterior surfaces of the kidney at each pole as shown in Fig 710. The fixation is carried out in the same manner as though the capsule alone

had been used as just described. This operation avoids decapsulating the kidney and requires much less time than when the capsule is used.

Group 3 Use of Last Rib, etc

This group includes slitting of the capsule and passing the twelfth rib through the openings, utilizing of subcapsular ribbon gut suspension, forming a hammock by using the perirenal and pararenal fat, etc.

RESECTION OF THE KIDNEY

Improved methods of hemostasis of cut surfaces of parenchymatous organs in general and of the kidney in particular have permitted rapid advances to be

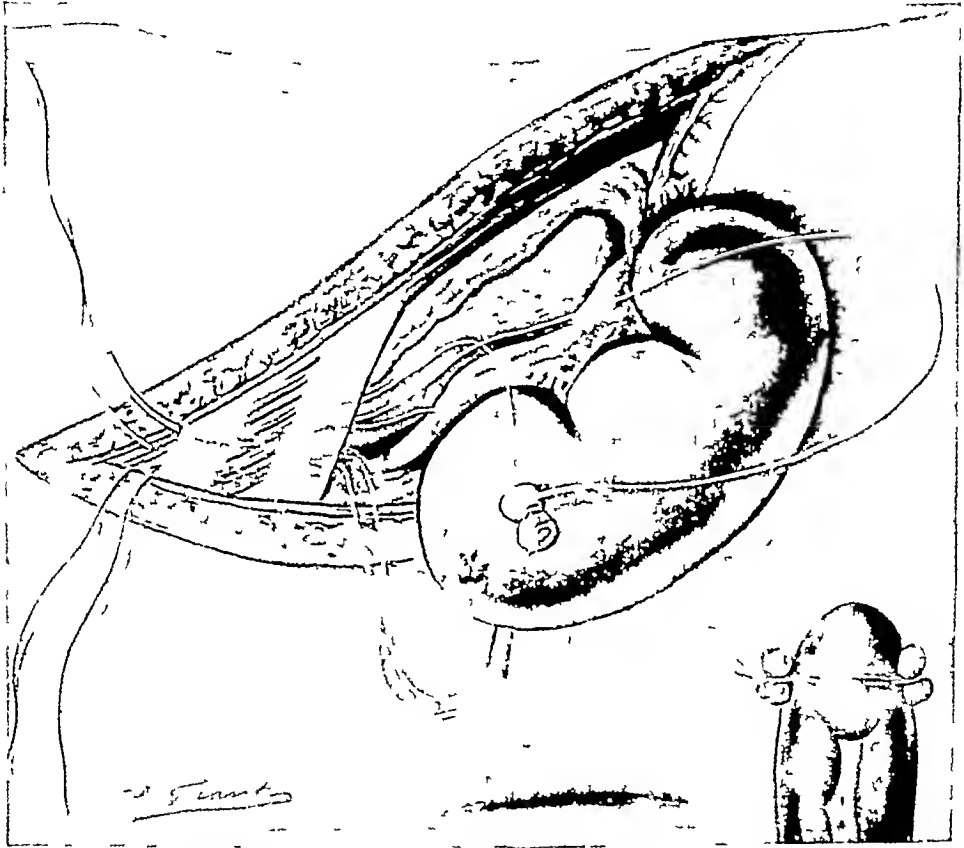


FIG 710—Papin's technic for nephropexy (Courtesy of Dr E Papin) First step A double catgut suture is passed through the upper pole of the kidney and the two ends tied over a piece of fat as shown in the insert. The four ends are then passed through the tenth intercostal space as shown in larger drawing and tied separately, i.e., the two anterior and the two posterior ends respectively (see also second step in Fig 711)

made in removal (a) of portions of a normally formed kidney and (b) of half of a double or horseshoe kidney and of the upper or lower segment of a crossed ectopic kidney.

The indications for resection of a normally formed kidney are

- 1 A localized hydronephrosis with or without (Fig 461) coincident calculus due to a stricture at the neck of a calyx
- 2 Solitary cyst
- 3 For extension of a large pelvic calculus into a single calyx (Scholl)
- 4 Benign neoplasm
- 5 Carbuncle of kidney

Hemostasis during the resection is obtained by passing a small soft rubber catheter (Fig 712) around the pedicle and preventing the tourniquet from opening by means of an artery forceps. This may not be necessary unless the resection involves a relatively large portion of the kidney. The method of hemostasis for the cut surface has been discussed under nephrotomy.

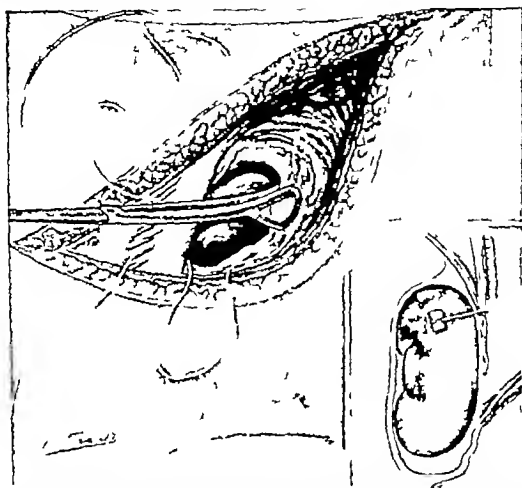


FIG. 711.—Second step of Papin's technique for nephropexy. Compare with first step shown in Fig. 10. The perirenal fat around the lower pole of the kidney is pulled up and a purse-string suture of catgut inserted so that the fat forms a support for the lower pole. In the insert is shown how the sutures (see Fig. 710) traversing the upper pole are tied over the intercostal muscles of the tenth interspace. (Courtesy of Dr. E. Papin.)

Removal of half of a double or horseshoe kidney is termed heminephrectomy, but no special term is applied to removal of the upper or lower segment of a crossed ectopic kidney (Figs 405, 407 and 408).

HEMINEPHECTOMY

Heminephrectomy for disease or neoplasm in one half of a double kidney is comparatively easy if there is a well marked line of demarcation between the halves as shown in Fig. 433, but quite difficult if it does not exist as in Fig. 432. Heminephrectomy is impossible if there is only one set of vessels for both halves (Fig. 713); of a double kidney, only complete nephrectomy can be done. Heminephrectomy in horseshoe kidney is much more difficult than in the preceding anomaly because of the many anomalous vessels (Fig. 409), each of which may require ligation and also because of the markedly large isthmus in many cases, which needs to be clamped before being divided.

Removal of one segment of a crossed ectopia anomaly does not differ from that of heminephrectomy in double kidney

The best method of closure of a cut surface in extensive resections or

FIG 712

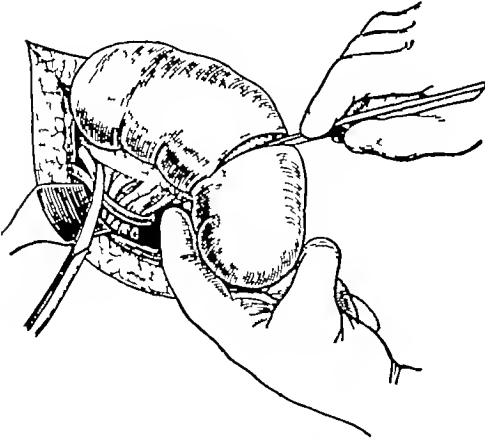


FIG 713

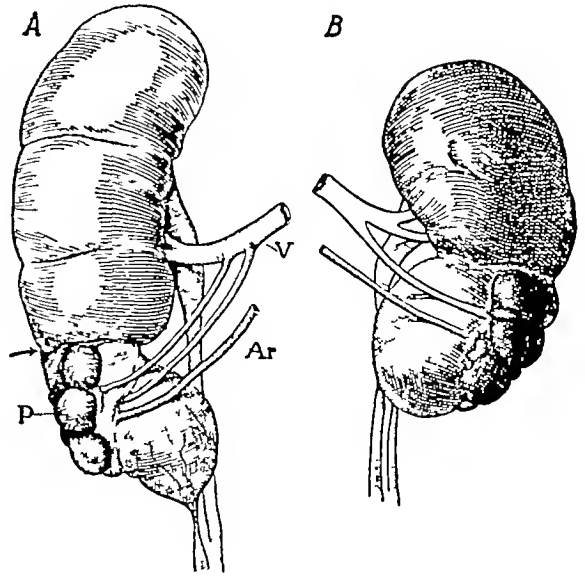


FIG 712—Technic of resection of the kidney Bleeding can be temporarily controlled by placing a small-sized soft-rubber catheter or tube around the pedicle The point of crossing of the catheter or tube is clamped by an artery forceps to prevent the temporary hemostatic constricting tube from opening (Courtesy of Dr E Papin)

FIG 713—A Right, double, kidney Note single blood supply for both halves and well marked line of demarcation as indicated by arrow

B Left, double, kidney of same case

The right lower half was removed on account of an infected hydronephrosis and the left lower half because of a large coral calculus

in heminephrectomy is, in our opinion, that shown in Fig 714 in which a combination is used of the Beer-Hagenbach principle (see also Fig 705) and covering the raw surface with a free fat transplant held in place by more superficial sutures

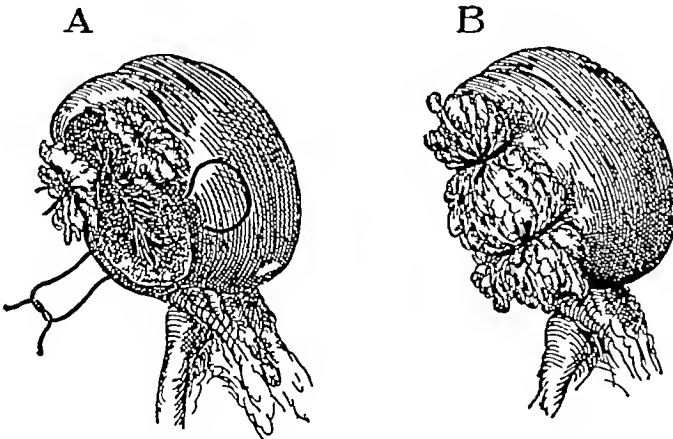


FIG 714—Method of resection of a part of a normally formed or of one half of a double kidney (see Fig 677)

A Beer-Hagenbach method (see Fig 675) of closure of cut surface

B Appearance of stump after closure of edges of resected surface

NEPHRECTOMY

When removal of the kidney is spoken of, the method commonly known as lumbar nephrectomy, i e, through the incision described at the beginning of this chapter, is the one referred to There are however two other routes of approach, the paraperitoneal and the transperitoneal, hence we will take up the technic of these three, separately

ORDINARY LUMBAR NEPHRECTOMY

The incision for exposure of the kidney is that described at the beginning of this chapter From this step to that of final ligation of the pedicle, it is neces-

sary to vary one's technic according to the nature of the disease which has given rise to the indication for removal of the kidney

Let us enumerate how the technic of a lumbar nephrectomy is subject to variations

A. If the pedicle is fairly long and the kidney not surrounded by dense adhesions and one is able to easily secure a line of cleavage between the true

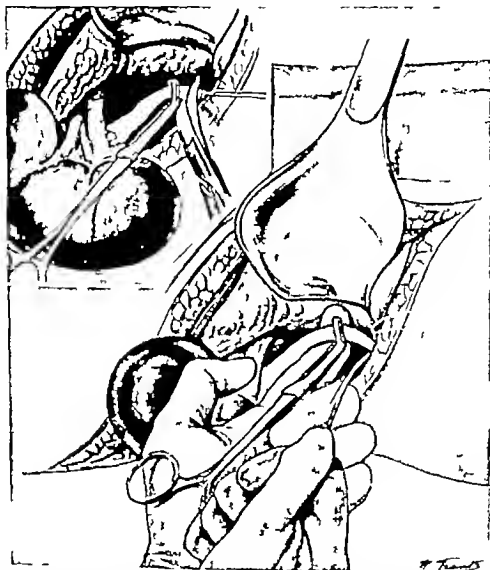


FIG. 715.—Ligation and division of the ureter prior to ligation of the pedicle in nephrectomy. This preliminary ligation of the ureter permits better mobilization of the kidney and its pedicle (Courtesy of Dr. E. Papin)

(fibrous) capsule and the surrounding fat, the technic is comparatively simple, even in cases of renal tuberculosis

The essential steps in a nephrectomy in which the pedicle is long enough (Fig. 679) so that the kidney can be easily brought into the incision are

- 1 To ISOLATE THE URETER AS CLOSE AS POSSIBLE TO THE KIDNEY and divide it with a scalpel or scissors between two catgut (preferably size 0 or 1 chromic) ligatures as shown in Fig. 715
- 2 To ISOLATE ANY ACCESSORY VESSELS (Fig. 26) to the upper or lower poles and divide them between two ligatures
- 3 To ISOLATE THE VESSELS OF THE RENAL PEDICLE leaving as little fat

Removal of one segment of a crossed ectopia anomaly does not differ from that of heminephrectomy in double kidney

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FIG 712

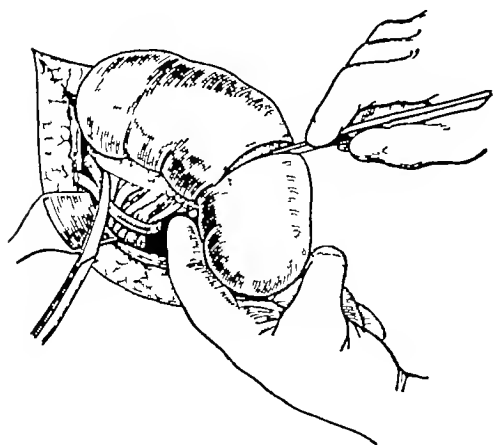


FIG 713

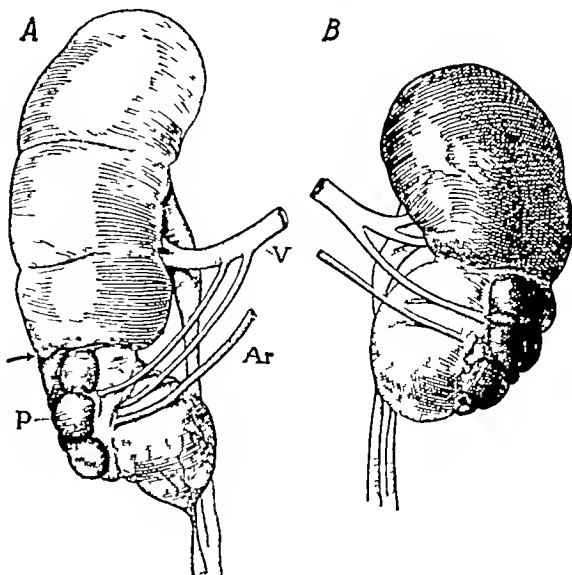


FIG 712—Technic of resection of the kidney. Bleeding can be temporarily controlled by placing a small-sized soft-rubber catheter or tube around the pedicle. The point of crossing of the catheter or tube is clamped by an artery forceps to prevent the temporary hemostatic constricting tube from opening (Courtesy of Dr E Papin)

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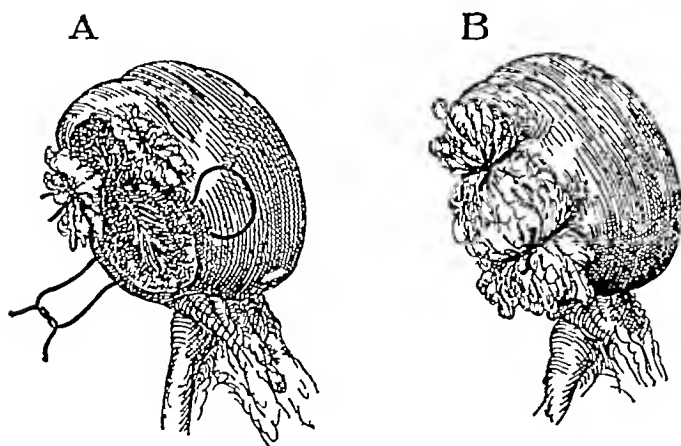


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FIG. 715.—Ligature and division of the ureter prior to ligation of the pedicle in nephrectomy. This preliminary ligation of the ureter permits better mobilization of the kidney and its pedicle (Courtesy of Dr. E. Papin)

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- 2 To ISOLATE ANY ACCESSORY VESSELS (Fig. 26) to the upper or lower poles and divide them between two ligatures
- 3 To ISOLATE THE VESSELS OF THE RENAL PEDICLE leaving as little fat

attached as possible. The pedicle should then be ligated at least twice, once by transfixion (Fig 717) and once en masse

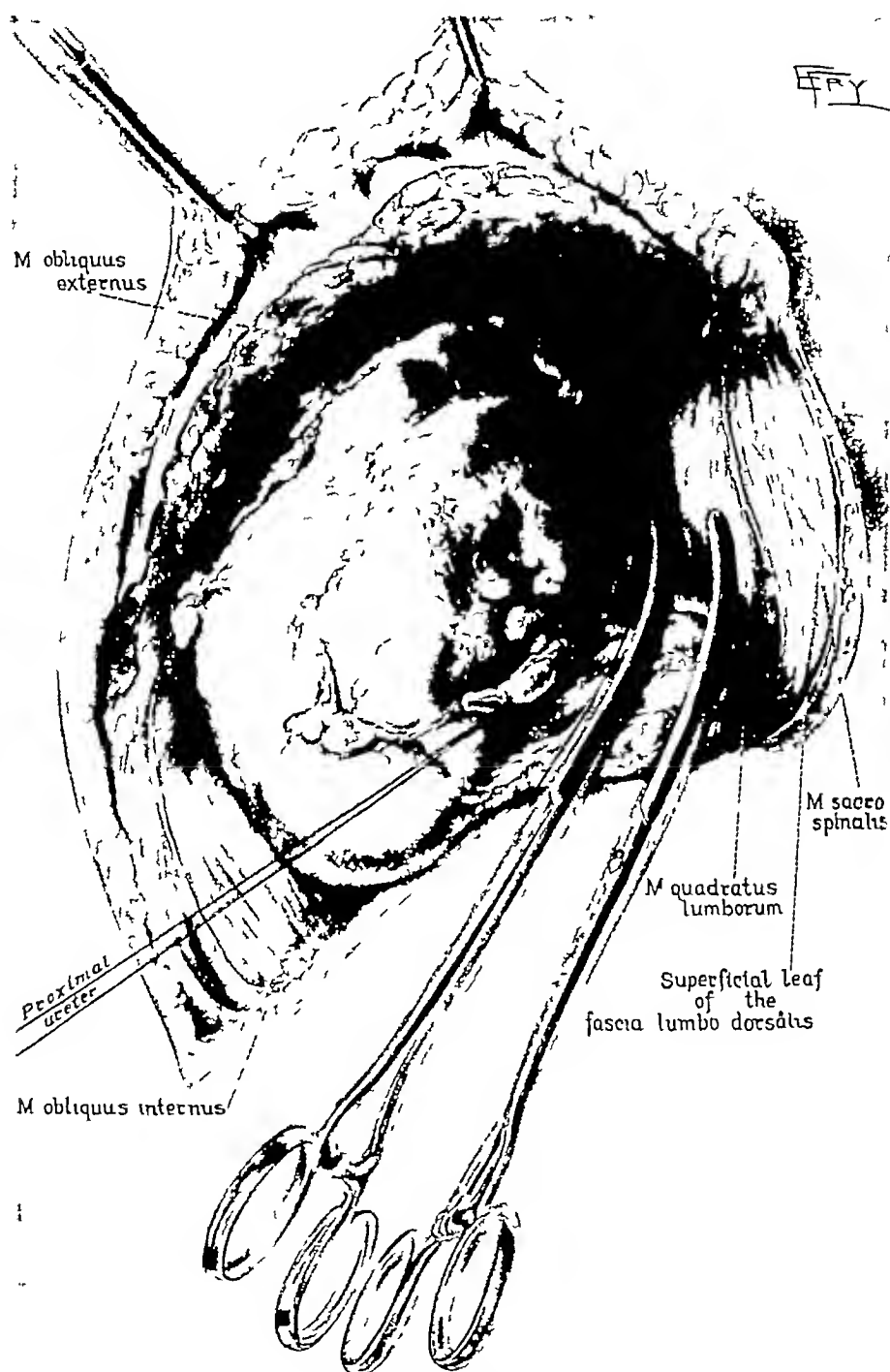


FIG 716—The W J Mayo two clamp method of nephrectomy. See Fig 681 for details of application

B There are many adhesions of the kidney to the surrounding tissues, but these can be separated readily. Everything depends on whether or not the pedicle is short, so that, the method just described, is especially applicable to a kidney with a relatively long pedicle.

If the abdominal wall incision has been made amply large, and the twelfth

rib completely mobilized by division of the costotransverse ligament (Fig 694) and the pedicle is still too short and the kidney so large that ligation of the

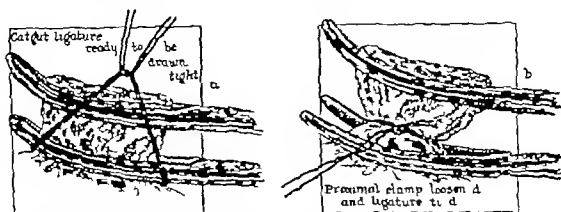


FIG. 717.—Two clamp method of W. J. Mayo for ligation of the renal pedicle

A. An en masse ligature is applied between the proximal clamp and the large abdominal vessels.

B. The proximal clamp is being loosened and withdrawn while the first ligature is tightened. Another ligature is next applied en masse before the second clamp is removed.

pedicle en masse and by transfixion is not easily carried out. It is far better to employ the W. J. Mayo two clamp method. One curved clamp (Fig 716) is



FIG. 718.—Operative specimen of tuberculous pyonephrosis showing the typical fibrous thickening of the perinephritic capsule. Note line of cleavage at upper and lower poles so that subcapsular nephrectomy is still feasible.

placed so as to include all of the vessels and surrounding fat as far away from the kidney hilum as possible. A second clamp is next applied in a similar manner

between the first one and the kidney. With a special scissors, whose curve or angulation corresponds with that of the pedicle clamps, the pedicle is next divided and the kidney removed. We are now ready to ligate the well clamped pedicle (see Fig 717).

If one has given this method a trial in difficult nephrectomy cases, an attempt to ligate the pedicle with the kidney still in situ will seldom be attempted again. The ease with which a short pedicle can be ligated by the employment of the two clamp method, is astonishing.

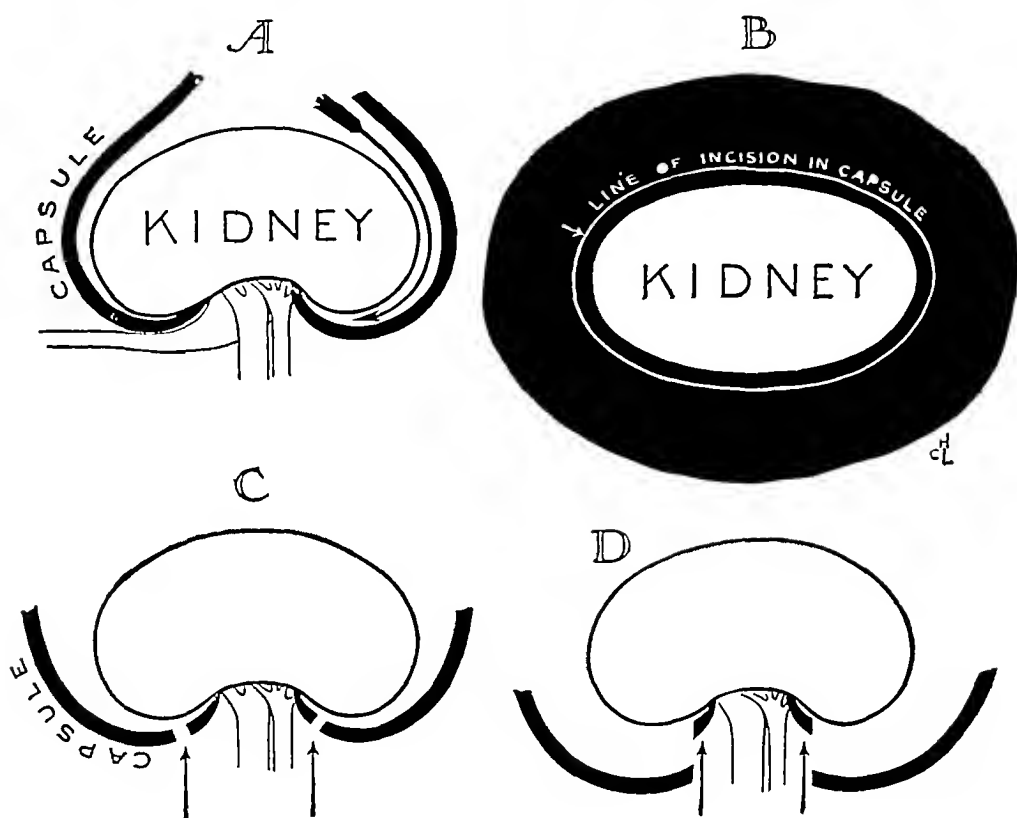


FIG 719—Diagrams to show steps of Federoff subcapsular nephrectomy

A Mass composed of greatly thickened and fused fatty and true capsules of kidney is divided and separation begun in line of cleavage (see Fig 718)

B Line of incision through reflected thickened capsule as shown in C as close as possible to pedicle

D Kidney can now be drawn out sufficiently to apply two clamp method (see Fig 716)

A fairly large (preferably number 2 chromic) catgut ligature encircles en masse the pedicle, distal to the clamp which lies closest to the vena cava and aorta. While it is being tied, the assistant slowly removes this most distal (i.e. from the kidney), clamp. One still has the second clamp in place as an additional safeguard against bleeding. We usually transfix the pedicle between the first ligature and second clamp and then permit the assistant to slowly loosen the proximal clamp, while this transfixion ligature is being tied (Fig 717).

C **Kidney Difficult or Impossible to Mobilize** We have just outlined the methods to be recommended for (A) cases with relatively long pedicle and a kidney which can be easily mobilized, and (B) for those cases with a very short

pedicle or a large kidney which were imbedded in separable adhesions. There is however a third group in which there are such dense adhesions between the kidney and greatly thickened perinephritic tissues that not only is mobilization of the kidney a very difficult task but access to the pedicle for the purpose of ligation without or even with clamps, practically impossible. We are indebted to W. J. Mayo, for calling attention⁷ to the method of Federoff⁸ of subcapsular nephrectomy for these most difficult cases. The greatly thickened perinephritic tissue is usually so adherent to the true or fibrous capsule in these cases that one must find a line of cleavage between the true capsule (Fig. 718) and the cortex of the kidney.

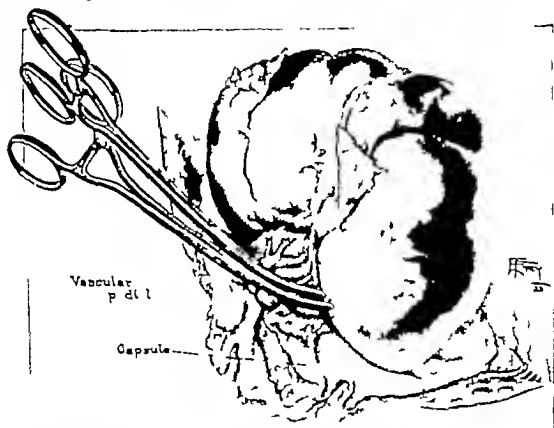


FIG. 720.—Subcapsular nephrectomy by the Federoff method. Note greatly thickened capsule reflected and clamps applied as explained in Fig. 716 (Courtesy of Dr. William J. Mayo)

SUBCAPSULAR NEPHRECTOMY

The first step in subcapsular nephrectomy is well shown in Fig. 719. The capsule (consisting of the two structures just mentioned) is stripped back toward the pedicle as far as possible (A of Fig. 719). An incision is next made in a circular manner (B of Fig. 719) through the entire thickness of this everted capsule as close to the pedicle⁹ as possible (C of Fig. 719). This enables one to make traction on the kidney sufficiently to enable the two clamp method to be applied (Fig. 720). It is surprising to note the degree to which the kidney can be pulled out (D of Fig. 719) when the pedicle is freed in this manner. We have found on numerous occasions that a knowledge of the two clamp and subcapsular nephrectomy methods combined with an ample exposure of the field has made what seemed insuperable difficulties comparatively simple affairs.

⁷Surg., Gynec. and Obst. 1917, 24, 1.

⁸It is of course understood that in both the ordinary two clamp method and in subcapsular nephrectomy the ureter has been previously ligated and divided.

NEPHRO-URETERECTOMY

There is a subtotal and a total or complete type of this operation. This latter type is to be warmly recommended for all cases of neoplasm of the renal pelvis or ureter, whether vesical metastases exist or not. In the subtotal operation, the kidney and the ureter down to its entrance into the bladder wall are removed. In

total or complete nephro-ureterectomy, the kidney and the entire ureter including its intramural portion and a cuff of bladder mucosa surrounding the ureteral orifice

Subtotal Technic Gutierrez (Ann Surg 1931, 93, 511) has given a good description of the technic of the subtotal operation. In the first stage, with the patient in moderate Trendelenburg position, an incision is made similar to that shown in Fig 738 for the inguinal approach to the pelvic ureter. The latter after having been isolated, is divided close to the bladder between two ligatures with the electric knife. To prevent any leakage from the proximal end, a piece of gauze is tied around it. The pelvic and iliac portions of the ureter are now mobilized and a temporary dressing placed over the inguinal incision while the patient is turned on his side and the kidney exposed and the pedicle ligated. It is now easy to deliver the mobilized ureter, still attached to the kidney, through the lumbar incision.

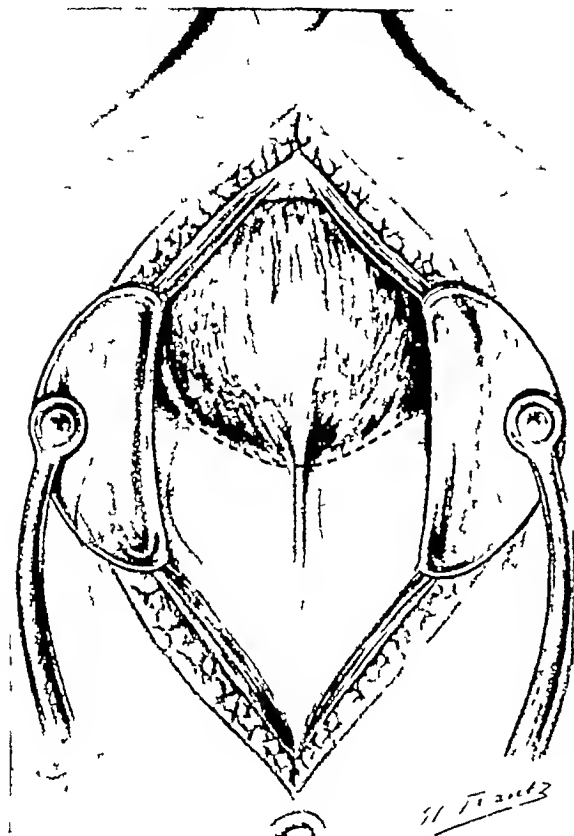


FIG 724—Step 2 of median approach for complete nephroureterectomy (Courtesy of Drs E Papin and R de Berne-Lagarde.) Following a median suprapubic exposure (step 1) (see Fig 727) the bladder is mobilized as much as possible and the peritoneal cavity opened along dotted line.

Total Technic An excellent technic of total or complete nephro-ureterectomy appeared in an article by Papin and de Berne Lagarde (Arch Mal des Reins 1936, 10, 1). The steps of the operation are the following:

STEP 1 Exposure of bladder (Figs 663 and 727) as for suprapubic cystostomy.

STEP 2 The unopened bladder is completely mobilized (Fig 724), following extraperitonealization which is Step 3 as shown in Fig 725.

STEP 4 Traction on unopened bladder until juxtavesical portion of the ureter (Figs 726 or 727) is exposed.

STEP 5 See Fig 727.

STEP 6 Incision through bladder wall, so as to include all (Figs 726, 727 and 728) of the intramural portion of the ureter, down to vesical mucosa.

Bladder is opened and mucosa surrounding ureteral orifice is divided and left attached to intramural ureter

STEP 7 Opening in bladder through which lower end of ureter was removed is closed by two rows of sutures and drain placed near suture line and brought through suprapubic incision

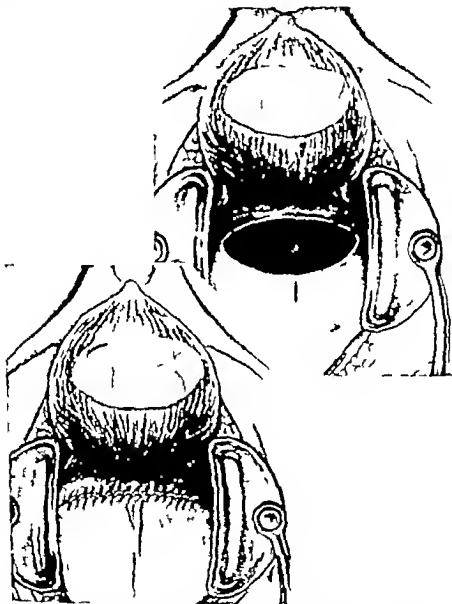


FIG. 725—Step 3 of median approach for complete nephroureterectomy (Courtesy of Drs. E. Papin and R. de Berne Lagarde.) This shows technic of extraperitonealization of the bladder carried out as follows: After leaving intact the area of attachment to the bladder (upper drawing) to the peritoneum, the opening in the latter is closed as indicated in the lower drawing.

The suprapubic incision is closed around drains (Fig. 673) into bladder and perivesical space

FINAL STEP Patient turned on side. Kidney and entire ureter including intramural portion and bladder mucosa around ureteral orifice removed en masse

DENERVATION OF THE KIDNEY

The innervation of the kidney has been considered in the chapter on Anatomy. Of chief interest from the standpoint of division of the sympathetic fibers is that they are divided into three groups which are to be found respectively along the

upper and lower borders of the renal artery and on its anterior surface. This last named, middle group (Figs 32 and 33) is inconstant and of little importance according to Dambrin. The groups along the upper and lower borders of the artery constitute the principal ones to be divided. Although some urologists prefer to expose the pedicle by the transperitoneal route, the majority employ the ordinary

lumbar incision as shown in Fig 689

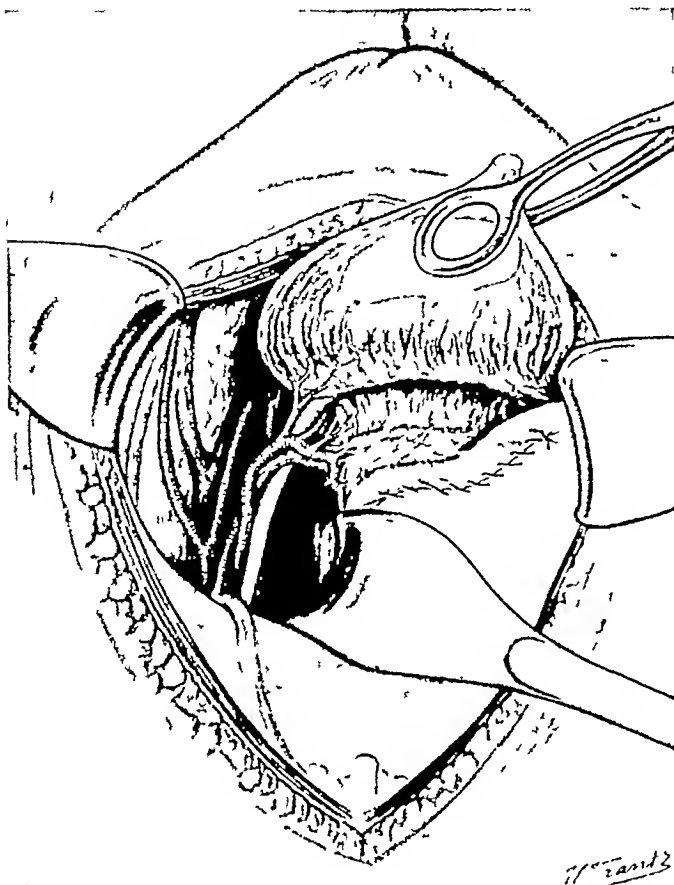


FIG 726—Step 4 of median approach for complete nephroureterectomy (Courtesy of Drs E Papin and R de Berne-Lagarde) The bladder is pulled forwards and to the right (in cases of left nephro-ureterectomy and vice versa) The point of crossing of the ureter by the uterine vessels (in this drawing) or by the vas deferens is very well exposed, so that it is easy to excise the portion of the bladder wall containing the corresponding ureteral orifice

Papin (*Jour Urol* 1924, 11, 337) was the first to employ denervation or renal sympathectomy as it is also termed for the relief of pain due to chronic nephritis, small hydronephroses and in nephralgia of unexplained origin. A review of the experimental evidence is to be found in an article by Gibson (*Jour Urol* 1936, 36, 334). The first to employ the term "sympathicotonia" in connection with disturbances of the nerve-muscle mechanism of the kidney were S H and R G S Harris (*Lancet* 1935, 1, 424). They limit the field of application to the relief of pain of increased renal tension in cases of urinary stasis arising from neuromuscular dysfunction of the renal pelvis, calices and upper portion of the ureter. Little or nothing is known of the etiological factors. The diagnosis as given by W P Herbst (*Jour Urol* 1937, 37, 249) is based on the his-

tory of either renal or ureteral colicky pain without any abnormal urinary findings. Roentgenologically, the most accurate method to employ is either pyeloscopy, plus several urograms (excretory or retrograde) or the serial urography method of Moore or Jarre and Cumming. Single urograms are never adequately informative. Herbst differentiates renal sympathicotonus and hyperdynamic motility of the upper urinary tract. In the former, the urographic findings consist of the localized spasm, which may occur anywhere from the papillae to the ureterovesical junction. In the hyperdynamic form, the renal pelvis and ureter cannot be adequately filled even under direct fluoroscopic vision with retrograde injection. Serial urograms will demonstrate a lack of filling of a very large portion of the urinary tract.

The technic of renal sympathectomy is shown in Fig 729. The vein should be retracted and the nerve fibrils isolated with the aid of a special long bladed scalpel before being divided. Injury of the renal vein has been reported by several authors. Legueu and Flandrin (*Arch Urol Necker* 1926, 5:163) observed marked atrophy of the kidney following denervation, necessitating nephrectomy a few months later.

Gibson (*loc. cit.*) states that he has punctured the vein in three cases but was able to suture the opening. Whether denervation should be combined with other operations such as nephropexy, decapsulation, etc. is still under discussion.

PLASTIC OPERATIONS FOR HYDRONEPHROSIS

Efforts to conserve the kidney should be made in cases of bilateral hydronephrosis and in the unilateral form when (a) the obstruction is of mechanical and not dynamic origin and (b) when sufficient functioning parenchyma remains to justify conservatism. The causes of obstruction at the ureteropelvic junction in the order of their frequency are:

Site of Hydronephrotic Obstruction

Group 1. Anomalous vessels to the lower pole (Fig 26) or obstruction of renal pelvis by a second artery or by branches of a single main renal artery (Fig 445).

Group 2. Lateral i.e. faulty insertion of the ureter (Fig 730).

Group 3. Kinking of ureter by peripelvic connective tissue (Fig 459).

Group 4. Stricture at or close to ureteropelvic junction.

The procedures most frequently employed at the present time for the relief of hydronephrosis will be enumerated in adhering to the above grouping. A brief description will follow.

Procedures

Group 1. Cases in which the anomalous vessels must be conserved.

(a) Reimplantation of the ureter (Quinby, Wildbolz).

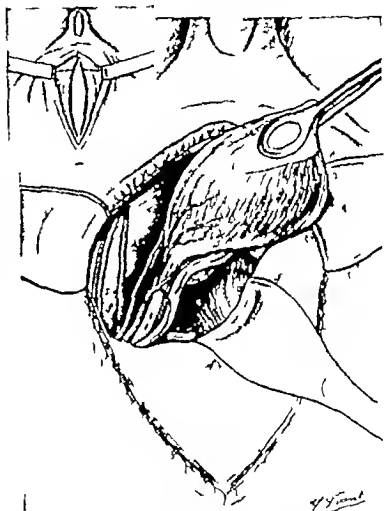


FIG. 7.—Step 5 of median approach for complete nephro-ureterectomy or for removal of calculi in juxtavesical portion of the ureter. (Courtesy of Drs. E. Papin and R. de Berne-Lagarde.) The insert shows suprapubic incision and division if needed for more space of the lower end of recti muscles. The main drawing shows incision in juxtavesical portion of the ureter for removal of calculi.

(b) Resection of the renal pelvis (Young, Walters)

(c) Transposition of vessels following resection (Hellstrom)

Group 2 Lateral insertion of ureter

(a) Lateral anastomosis of ureter and renal pelvis or ureteropyeloneostomy (Bazy, von Lichtenberg)

(b) Reimplantation

(c) Resection of renal pelvis with or without nephropexy

Group 3 Kinking of ureter by peripelvic connective tissue

(a) Ureterolysis followed by resection (Walters)

(b) Reimplantation

Group 4 Stricture at or close to ureteropelvic junction

(a) Foley Y-plasty

(b) Resection of stricture followed by reimplantation

As a rule, the various procedures enumerated above should never be undertaken unless urography and renal function tests show that sufficient parenchyma exists and functions to justify a conservative operation. Furthermore, every effort should be made either before or during the operation to ascertain that the obstruction is of mechanical and not of dynamic (neuromuscular) origin.

Special Features There are certain features of the technic which need to be emphasized. These are

1 IN BADLY INFECTED CASES, preliminary ureteral catheter drainage and lavage of the renal

pelvis should be done until the urine is clear and, if possible, sterile on culture examination

2 DRAINAGE MUST BE PROVIDED for, after operation, best of all, by nephrostomy. Some operators use a ureteral catheter as a splint in cases of reimplantation (Fig 730) and allow drainage to take place either from the pelvis or directly or through the renal parenchyma. In a recent discussion, Quinby (Jour Urol, 1936, 36, 528) stated that he never employs a splint, in the form of a ureteral catheter, passed through the level of the anastomosis.

3 NEPHROLYSIS AND URETEROLYSIS, i.e., removal of all connective tissue sheaths which have kinked the ureter must be done as a preliminary procedure.

4 IF ABNORMAL MOBILITY OF THE KIDNEY has been the primary cause of the ureteral obstruction and the pyelectasis and displacement laterally of the ureter a secondary complication, a nephropexy, should follow the plastic procedure.



FIG 728—Close-up of relations of juxtavesical portion of the ureter in the female (compare with Fig 727) (Courtesy of Drs E Papin and R de Berne-Lagarde)

5 ACCURATE APPROXIMATION with fine plain catgut and avoidance of any tension on the suture line are indispensable

The postoperative complications are (a) acute pyelonephritis presenting as high temperature and pain over the kidney (b) retention of urine as shown by excretory urography and (c) stricture formation at the site of anastomosis. In connection with the latter it is advisable in cases in which reimplantation is



FIG. 720.—Papin technic of denervation of renal pedicle. Note how nerves along lower border of the main renal artery are being isolated before their division. The renal vein is retracted so as to avoid injury. (Courtesy of Dr. E. Papin.)

done for obstruction by accessory vessels to pass a catheter in a retrograde manner through that portion of the ureter which was compressed to be sure that a stricture does not exist. If this is the case it is better to resect the area.

The criteria of a good result are (a) Disappearance of all symptoms, such as pain, fever, pyuria, etc., and (b) Return of the pelvis to approximately normal size with no evidence of retention as shown by urography and function tests.

Cases need to be followed for five to ten years before a definite opinion can be formed as to the end result. In the patient whose urogram is shown in Fig. 460 a plastic operation was performed fifteen years previously by an excellent operator. No symptoms presented until shortly before being seen by one of us. The specimen is shown in Fig. 459.

ESSENTIALS OF TECHNIC OF MORE FREQUENTLY EMPLOYED PROCEDURES

A Reimplantation The ureter is sectioned close to the renal pelvis and

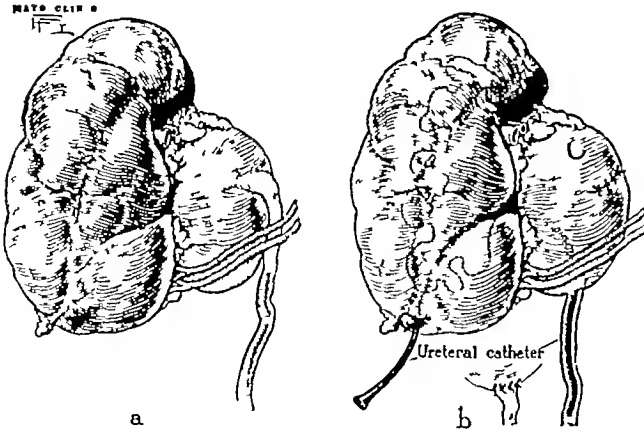


FIG 730—Reimplantation of ureter for high origin and obstruction due to lower polar vessels (Courtesy of Dr Waltman Walters and of Surgery, Gynecology and Obstetrics)

A Note high origin of ureter B Note how ureter is reimplanted in most dependent part of pelvis

an opening made at the most dependent portion of the renal pelvis (Fig 730) followed by anastomosis of the cut end of the ureter to this opening in the renal pelvis, i e, on the principle of an end-to-side anastomosis of the intestine This method is employed by Quinby, Wildbolz, Walters and others in cases of obstruction of the ureter by anomalous blood vessels and for ureteral stricture at the uretero-pelvic junction

B Resection of the Renal Pelvis An area varying in size and form according to the degree of distension of the extrarenal

portion of the pelvis is excised and the edges approximated In some cases, the resection is limited to the anterior surface alone, in others it may be necessary to resect both the anterior and posterior aspects (Fig 731) This method has been employed by Walters for lateral insertion of the ureter and by Young (Surg Gyn and Obst, 1932, 54, 26) for anomalous blood vessels (Fig 731) which are too large to ligate In order to determine the latter, a rubber-covered artery forceps lightly closed, over the anomalous artery, will cut off the circulation to the area supplied by the vessel The corresponding portion of the kidney becomes cyanotic and the operator can soon form an opinion as to the importance of the anomalous artery

Hellstrom (Zeit Urol Chir 1934, 39, 160) in order to avoid ligation of a large anomalous artery, mobilizes it and the accompanying vein and places them at a higher level on the renal pelvis, where they are attached by sutures

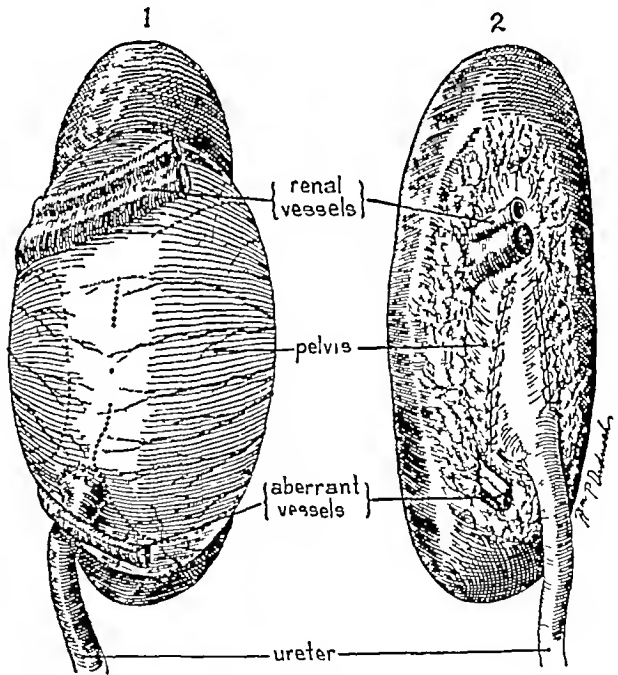


FIG 731—The Hugh H Young technic of resection of pelvis in hydronephrosis due to accessory artery to lower pole of kidney 1 The dotted lines indicate extent of resection 2 Incisions closed and separation of vessels from ureter (Courtesy of Dr H H Young and of Surgery, Gynecology and Obstetrics)

C Lateral Anastomosis of the Ureter and Renal Pelvis The principle of this method is that of the Finney operation for pyloric stenosis, i e lateral

anastomosis of the stomach and duodenum. In applying this technic to the treatment of hydronephrosis a longitudinal incision (Fig. 732) is made over the ureter and renal pelvis respectively and the two united by interrupted sutures of plain fine catgut for union of the two mucosal surfaces, reinforced by a line of interrupted fine catgut sutures to unite the outer surfaces. This type of operation has been employed by von Lichtenberg, Walters and others for lateral ureteral insertion.

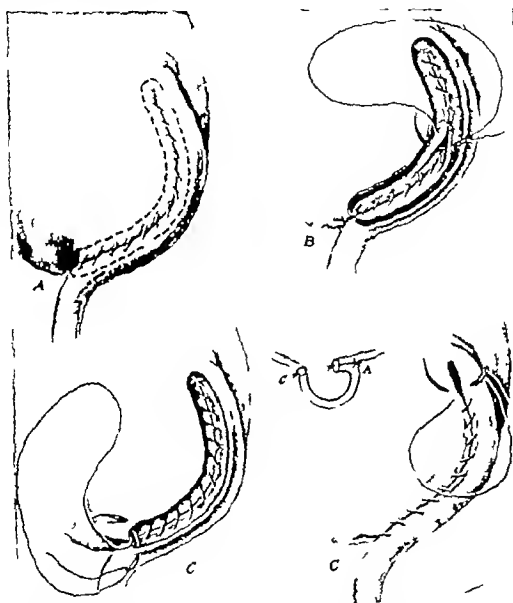


FIG. 732.—Von Lichtenberg technic for lateral anastomosis of ureter and renal pelvis. The successive steps are shown in A to C and in the inset (Courtesy of Dr. E. Papin.)

D Ureterolysis. This operation consists in removal preferably by sharp dissection of any connective tissue sheaths causing angulation (Fig. 459) and collapse of the ureter. Walters (*Surg. Gyn. and Obst.* 1932: 52: 508) reports some very satisfactory end results following use of this technic.

E. Plastics to Enlarge Lumen of Ureter Following Stricture Close to Renal Pelvis. The high percentage of failures following the use of the Jenger technic has resulted in its being discarded by most urologists. This operation was based on the principle of the Heineke-Mikulicz pyloroplasty, viz. linear division of the strictured area and closure in a horizontal manner.

An operation which appears to solve the difficulties encountered in the Fenger type of ureteroplasty was suggested by Schwyzer and modified by Foley. A Y-shaped incision is made over the ureteropelvic junction and closed as shown in Figs 733 and 734 (see also Jour Urol 1937, 38, 643)

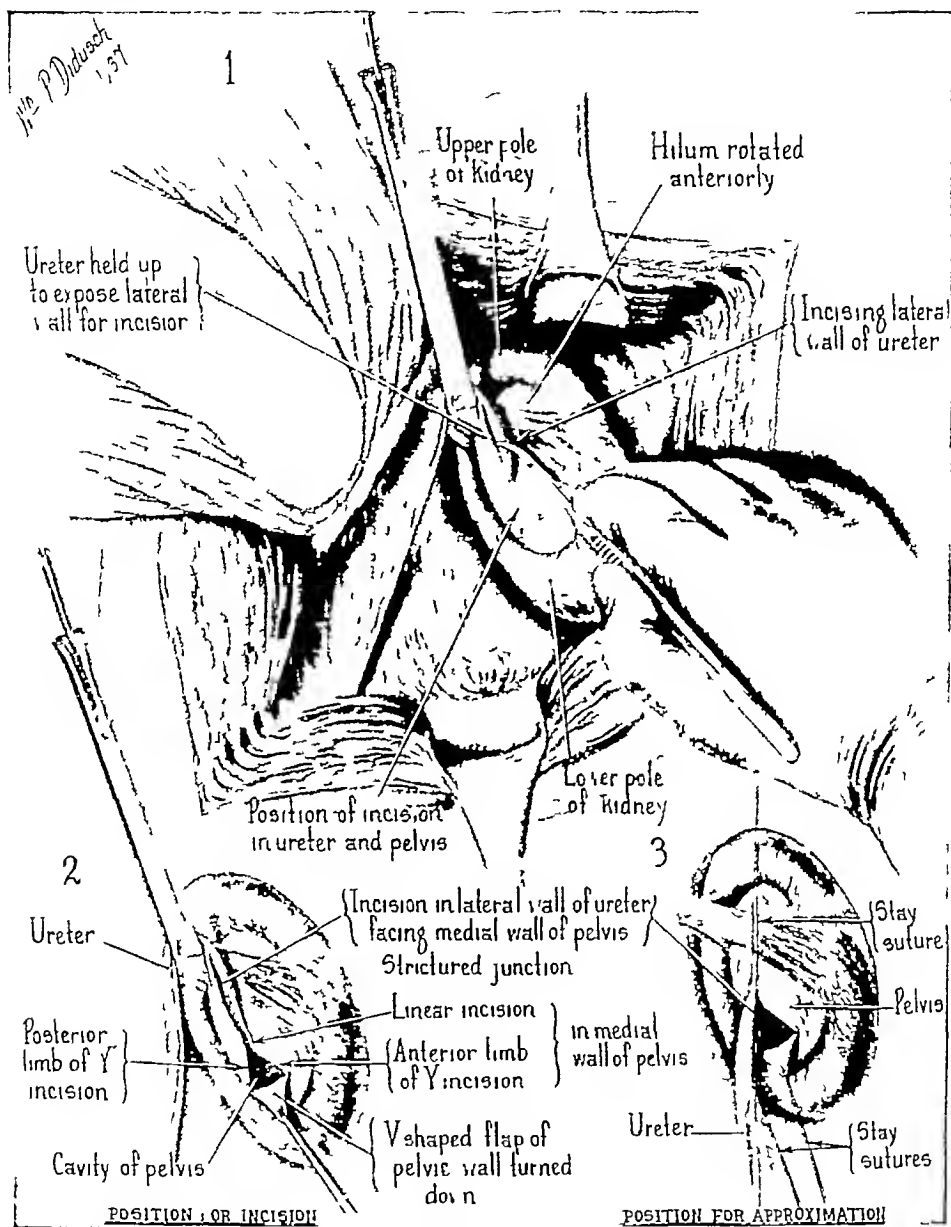


FIG 733 —Foley-Y-plasty for uretero-pelvic junction stricture (Courtesy of Dr F E B Foley and of Journal of Urology)

ACCIDENTS DURING KIDNEY OPERATIONS

These can be grouped as follows

Group 1 (a) Bleeding from overlooked vessels to the poles of the kidney (Figs 26 and 27) or crossing (Fig 701) the posterior aspect of the renal pelvis (encountered during posterior pyelotomy)

(b) Bleeding from the renal pedicle because of too loosely applied ligatures or cutting through of the pedicle clamps, before ligation has begun

(c) Injuries to the Vena Cava Up to 1930, Lavrov (Abstracts, Zeit

Urol Chir 1931 33 248) collected 37 cases with 51.4 per cent recoveries. Packing was used in 3 cases with 2 recoveries, clamps were left in situ, five times, with 6 recoveries, the vein was ligated in 11 cases with 7 recoveries and suture was employed in 9 cases with 2 recoveries. Ligation is the method of choice for injuries below the origin of the renal veins but suture is preferable

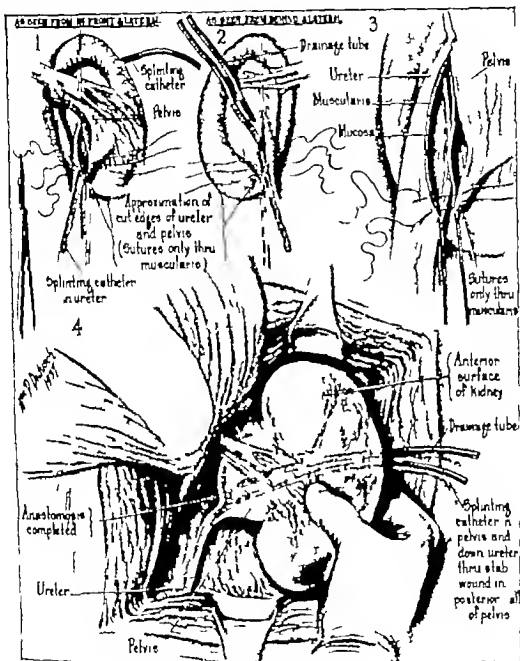


FIG. 734—Foley Y-plasty for uretero-pelvic junction stricture (Courtesy of Dr. F. E. B. Foley and J. Journal of Urology)

for injury above that level. A number of additional cases have been collected by Goldstein (Surg. Gyn. and Obst. 1937 65 515) and cases not included by this author and Lavrov are one by Nora in which recovery followed application of clamps for five days. Bonamone two recoveries following suture and Sedjukov a case in which the treatment is not given.

(d) Injuries to the Duodenum. Attention has already been called at the beginning of this chapter to the close relation of the duodenum (Fig. 698)

to the right kidney and to the variations in its relation (Fig 735) Ockerblad and Gonzales (Amer Jour Surg 1935, 28, 105) were able to find reports of 25 cases of duodenal fistula following nephrectomy, with 12 deaths. In their own case, the fistula followed nephrectomy for a perinephritic abscess secondary to a calculous pyonephrosis.

(e) **Injury to the Adrenal** This may occur as the result (a) of such intimate adhesions to the kidney, that separation is impossible, and (b) because of the inclusion of the adrenal within the renal capsule. Davie (Brit Jour Surg 1935, 22, 428) found the former condition on both sides 6 times in 1500 necropsies. Weller (Amer Jour Med Sci 1925, 169, 696) found 13 reported cases of inclusion of the adrenal in the kidney, a condition to which the term suprarenal-renal heterotopia has been applied. It was bilateral in 10 of the

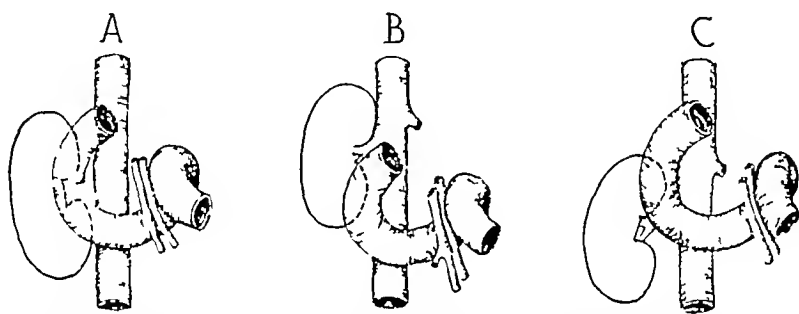


FIG 735—Variations in relation of the duodenum to the right kidney (After Corning)

A Second portion of duodenum in close contact with hilus of kidney

B Same with lower pole only

C With upper pole

These relations are of considerable importance to bear in mind in mobilizing the kidney and in applying the clamp to the renal pedicle.

13 cases, 10 of whom were males. Caylor (Jour Urol 1928, 20, 197) reported a case in which the adrenal gland was found altogether beneath the capsule of a kidney removed for hydronephrosis. No symptoms of adrenal insufficiency were noted following the operation.

(f) **Injury to the Pancreas** This is very rare. Young and Colston (Jour Urol 1917, 1, 179) reported a case verified at necropsy, following application of clamps for bleeding from an aberrant vessel after nephrotomy for calculus. They emphasize the fact that pancreatic injury occurs as a rule during operations on the right kidney and that it should be suspected in the presence of extreme abdominal distention and rapid prostration. A search of the literature since publication of the above case failed to reveal any additional ones.

OPERATIONS ON THE URETER

SURGICAL ANATOMY OF THE URETER

There are certain anatomical points which it is well to keep in mind in order (a) to understand the various incisions employed in exposing the iliac and pelvic portions of the ureter and (b) to avoid complications during and after ureteral operations.

The surgical anatomy involved in exposure of the lumbar ureter, i.e., from the kidney to the crest of the ilium as shown in Figs 681, 682, 683 and 692

does not differ from that described at the beginning of this chapter. Exposure of the iliac and pelvic (Figs 35, 36 and 38) portions of the ureter requires division of the muscles forming the lower third of the anterior abdominal wall.

The essential points to remember in exposure are the following as seen in Figs 736 and 737:

1 THE APONEUROSIS OF THE INTERNAL OBLIQUE MUSCLE is the first structure encountered in incisions which are lateral to the outer border of the rectus muscle of the respective side.

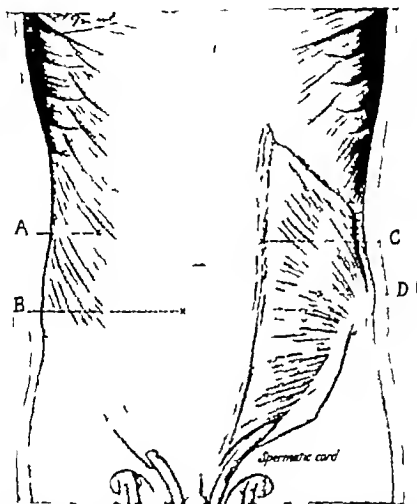


FIG 736.—Muscles and fascial sheaths of the anterior abdominal wall (See also Fig. 737.)
A. External oblique muscle, with its fibers directed downward and inward ending in the aponeurosis of this muscle, which forms a portion of the anterior sheath of the rectus muscle (see Fig. 737). On the left side the anterior fibers of the external oblique and its aponeurosis (C) have been removed, so as to show the internal oblique muscle (D) whose lowermost fibers unite with the aponeurosis of the external oblique to form the anterior sheath of the rectus.

2 BENEATH THE EXTERNAL OBLIQUE one encounters the fibers of the internal oblique muscle which are directed downwards and inwards from the outer half of Poupart's ligament.

3 THE TRANSVERSALIS MUSCLE at this portion of the abdomen is very thin but can be separated easily from the underlying peritoneum.

4 THE RECTUS ABDOMINIS on each side of the median line is enclosed in a sheath formed by the three other muscles of the anterior abdominal wall i.e. the external oblique, internal oblique and transversalis (see Fig. 737).

5 THE COURSE OF THE DEEP EPIGASTRIC VESSELS corresponds to a line drawn from the middle of Poupart's ligament to the umbilicus. These vessels lie between the peritoneum and transversalis fascia. They may require ligation in order to secure better exposure of the pelvic ureter.

6 THE PERITONEUM can be displaced mesially, if not too much force is employed or no adhesions to the iliac vessels or ureter exist, everywhere except

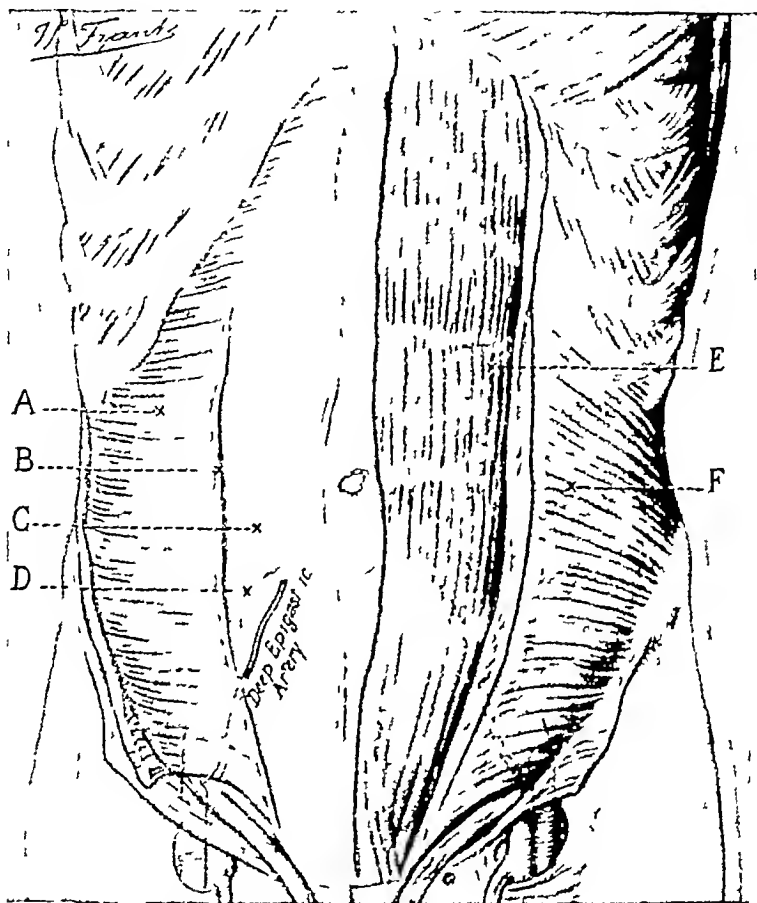


FIG 737—Deeper layers of anterior abdominal wall (See also Fig 736) A Transversalis muscle B Edge of anterior sheath of the rectus muscle formed above the semilunar fold (D) by the aponeuroses of the external obliques, internal oblique and transversalis muscles (shown at C). Note course of deep epigastric artery which lies in subserous tissue behind rectus muscle which has been removed on the right side. On the left side are shown the rectus muscle (E) and the internal oblique muscle (F). The deep epigastric artery is shown in dotted line because it passes upward between the peritoneum and the posterior sheath of the rectus muscle formed by the very thin transversalis fascia.

over the fundus (Fig 37) of the bladder, where the peritoneum is so firmly adherent that this area must be left in situ by opening the peritoneum and closing it again, a procedure termed extraperitonization of the bladder (Figs 724 and 725).

7 THE URETER is so firmly attached to the peritoneum lining the posterior wall of the abdomen, from a point just below the kidney downwards, that it must be looked for first on the outer surface of the displaced peritoneum. If not found there, a good starting point is the crossing of the iliac vessels by the ureter (Fig 36). A very useful method in order to keep the ureter constantly in view is to place a loop of catgut around it, as soon as it has been separated from the peritoneum.

The variation in the relations of the pelvic ureter in the male and female were taken up in Chapter 2

MOST FREQUENTLY EMPLOYED INCISIONS FOR URETERAL OPERATIONS

A For calculi in the lumbar portion, the same incision is employed as for operations on the kidney. By lifting up the latter and good retraction of the muscles of the lower edge of the incision and of the peritoneum, the ureter

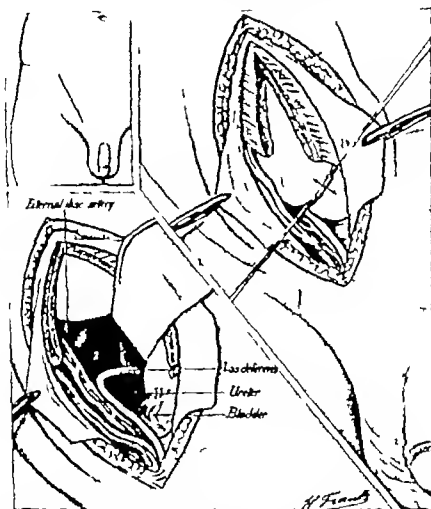


FIG. 738.—Ordinary iliac incision for exposure of pelvic portion of the ureter (Courtesy of Dr. E. Papin). The skin incision begins about two fingers breadth mesial to the anterior superior spine of the ilium, passing downwards and mesially about one finger's breadth above Poupart's ligament to end close to the external inguinal ring. The external oblique aponeurosis is divided parallel to its fibers. In order to obtain adequate exposure of the ureter it is advisable in most cases to divide the internal oblique muscle at right angles to its fibers (upper right drawing). The peritoneum is now displaced medially (lower left drawing) and the ureter found lying in close contact with the peritoneum. In the male, the vas deferens crosses the ureter at about the middle of its pelvic portion. In difficult cases, it is advisable to divide the deep epigastric artery between two ligatures.

can be easily exposed and an incision made over the calculus. If the ureter is greatly dilated so that (Fig. 536) the calculus slips back into the renal pelvis or downwards toward the bladder it is advisable for the operator to grasp the calculus between the index finger and thumb while an assistant places a temporary sling of catgut above and below the calculus so as to prevent its being displaced in upward or downward direction.

B For Calculi in the Iliac and Pelvic Portions of the Ureter. One has the choice of three types of incision as follows:

(A) INCISIONS OF THE ILIAC TYPE

1 THE ORDINARY ILIAC INCISION This is the one which has been most frequently employed by us in the removal of calculi and in subtotal ureteronephrectomy The incision down to the aponeurosis of the external oblique extends from a point about one inch mesial to the anterior superior spine of the ilium

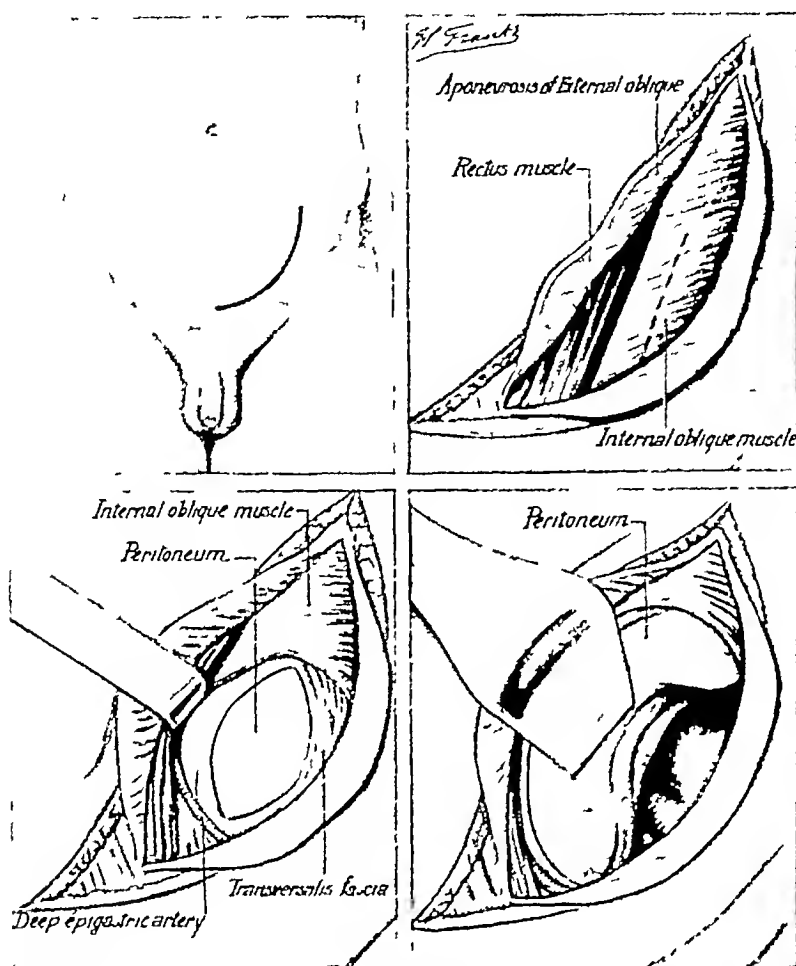


FIG 739—Gibson incision for exposure of pelvic portion of the ureter (Courtesy of Dr E Papin) The skin incision begins near the median line, about a finger's breadth above the symphysis pubis, curving slightly outwards to end about two fingers breadth from the anterior superior spine of the ilium After division of the external oblique aponeurosis (right upper drawing) and the internal oblique muscle, as much as possible parallel to its fibers, the posterior sheath of the rectus formed by the Transversalis fascia (see Fig 737) is divided (lower left drawing) The exposed peritoneum is displaced mesially (lower right drawing) and the ureter is seen attached to the peritoneum

(Fig 738) parallel to and about an inch above the inguinal fold to the outer border of the Rectus muscle The external oblique aponeurosis is divided parallel to its fibers and the internal oblique fibers separated bluntly as in the muscle splitting (McBurney) operation This muscle can be divided later if more space is needed The transversalis muscle is extremely thin at this portion of the abdominal wall and should be carefully incised, lest the peritoneal cavity be opened The peritoneum now presents and is gradually displaced mesially (Fig 738) and kept so with the aid of the Kelly or a similar fairly large retractor beneath which a laparotomy sponge has been placed so as to avoid

tearing the peritoneum. The ureter, as stated above, must be looked for on the outer aspect of the retracted peritoneum to which it is firmly attached. If it cannot be easily found, trace the ureter upwards or downwards from its point of crossing the iliac vessels (Fig 36) and place a temporary loop of catgut around it. Much additional space can be secured for removal of calculi from

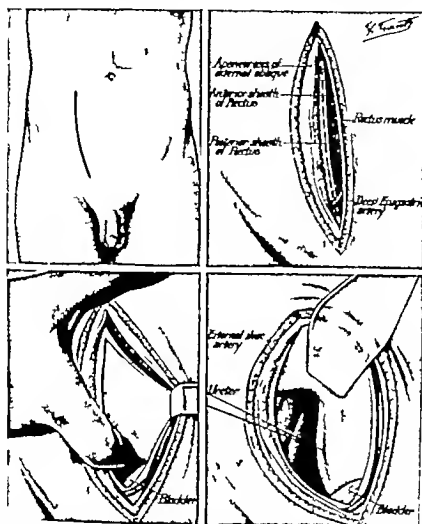


FIG. 740.—Pararectal incision for exposure of pelvic portion of the ureter. The skin incision is made parallel to the outer border of the rectus muscle, as shown in the upper left drawing. After vertical division of the anterior and posterior sheaths of the rectus muscle (upper right drawing) the peritoneum is displaced medially (lower left drawing). The ureter is found more or less adherent to the peritoneum but can be separated with the aid of a curved blunt-pointed scissors and isolated by passing a loop of catgut around it (lower right drawing). (Courtesy of Dr. E. Papin.)

or division of the juxtavesical portion of the ureter by division of the deep epigastric vessels between ligatures.

2 THE GIBSON MODIFICATION (Fig 739) of the ordinary iliac incision. The skin incision is made parallel to the course of the fibers of the external oblique aponeurosis, starting one inch inside the semilunar line and extending upwards and outward for a distance of four inches. The external oblique aponeurosis is divided parallel to its fibers. An incision is then made in the conjoined tendon of the internal oblique and transversalis as they join to form the anterior sheath of the rectus and the muscles spread apart with the aid of a hemostat. The peritoneum now comes into view and is gently pushed aside and search for the ureter made as described above.

(B) **PARARECTAL INCISION (Fig 740)** This is made parallel to the outer border of the rectus muscle whose anterior sheath is divided for a distance of four inches. The rectus is retracted mesially and its very thin posterior sheath divided, exposing the peritoneum which is displaced upwards and laterally.

(C) **MEDIAN INCISION WITHOUT EXTRAPERITONIZATION OF THE BLADDER** The exposure of the bladder, previously distended with water, does not differ from that employed in suprapubic cystotomy (Chapter 52). The bladder contents are evacuated by urethral catheterization and traction made on the empty bladder (Fig 727) toward the opposite side from that on which the ureteral calculus is located or whose juxtavesical ureter one desires to divide between ligatures.

(D) **MEDIAN INCISION WITH EXTRAPERITONIZATION OF THE BLADDER** This method is especially applicable to cases in which complete nephro-ureterectomy

becomes necessary for neoplasms of the renal pelvis or ureter. The technic has been described in a preceding part of this chapter, under Nephroureterectomy.

GENERAL CONSIDERATIONS

With the exception of operations on the lumbar ureter through the ordinary kidney incision, it is preferable to place the patient in a modern Trendelenburg position and to use either a head-lamp or a Cameron light, especially for operations on the pelvic ureter. It is unnecessary to

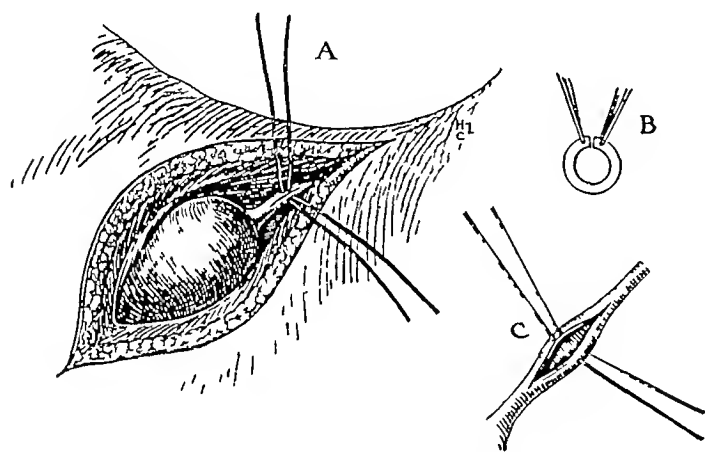


FIG 741—A The lumbar portion of the ureter is exposed through an oblique incision such as one employs for kidney operations (B of Fig 689). Traction sutures are inserted on either side of the ureterotomy incision. The depth to which they are inserted is shown in B and the manner in which edges of ureterotomy incision can be retracted is shown in C.

suture the ureter following removal of a ureteral calculus, but ample drainage must be provided for. A rubber tube should never be placed in direct contact with the iliac vessels, lest a necrosis of the vessel wall with fatal hemorrhage follows. Such cases have been reported in the earlier period of urological surgery. We prefer to use the Penrose type of rubber-dam drain to avoid any pressure effects.

URETEROLITHOTOMY

For calculi located in the lumbar portion (Fig 741) of the ureter, the incision ordinarily employed for kidney operations suffices. For calculi in the iliac and pelvic portions, we can recommend the first of the iliac incisions (Figs 738 and 742) for use by the operator with average skill and experience. Some urologists prefer the Gibson or the pararectal incisions (Figs 739 and 740). The median route (Fig 727) is to be especially recommended (without extraperitonization of the bladder) for impacted calculi in the juxtavesical portion of the ureter.

In all ureterotomies, a catheter must be passed in both a proximal and distal direction from the ureterotomy incision so as not to overlook nonopaque

calculi and strictures, lest a fistula follow the operation if a distal obstruction exists. In some cases of impacted calculi of long standing the thickening of the ureteral wall is so marked that it is difficult to palpate a calculus hence it is better to open the ureter proximal to the iliac vessels and pass a ureteral catheter toward the bladder. It must not be forgotten that (see Chapter 30) a calculus which has remained fixed for a long time may have caused decubital ulceration with subsequent stricture formation (Fig. 364). This predisposes to pyelonephritis or the ureterotomy is followed by a fistula, necessitating nephrectomy unless reimplantation into the bladder can be done.

URETERECTOMY

As a primary operation this always constitutes a part of a nephro-ureterectomy. The latter is termed incomplete or subtotal when only the ureter down to its point of entrance into the vesical wall is removed and complete or total when the entire ureter including its intramural portion and a cuff of vesical mucosa surrounding the corresponding ureteral orifice is removed with the kidney. The indications and technic of subtotal and total ureterectomy were described earlier in this chapter.

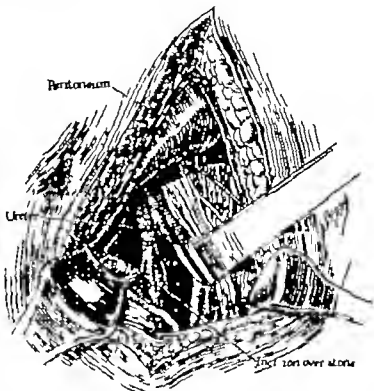


FIG. 742.—Topographical relations as seen during ureterotomy for calculus in pelvic portion of ureter. The iliac vessels are retracted outward and the peritoneum inward. The displacement of the vessels has been somewhat exaggerated by the artist.

As a secondary operation, ureterectomy may be necessary if the complete operation has not been done for neoplasms of the renal pelvis and there is evidence of a ureteral metastasis. It is also indicated in empyema of a ureteral stump following nephrectomy for renal tuberculosis.

DIVERSION OF URINE FROM THE BLADDER

All methods for the ureteral diversion may be grouped under the following classification according to Hinman and Weyrauch (Transactions Amer. Assoc. Genito-Urinary Surgeons 1936) who have made a critical study of the question of uretero-intestinal implantation.

CLASSIFICATION

- 1 Non Intestinal
 - A. To the skin.
 - B. To other structures (urethra vagina fallopian tube uterus blood vessel meninges of spinal cord bladder)

2 Intestinal

- A Into a completely or partially excluded portion of the tract
- B Into the intact tract

1 NON-INTESTINAL

Only two of the methods in this group have stood the test of clinical application. These are (a) implantation of the ureter to the skin and (b) implantation into the bladder.

Ureteral Transplantation to the Skin

This is often indicated in cancer of the bladder, uterus and prostate in order to prolong life. It has also been employed in cases of vesical tuberculosis resistant to all treatment. We have found that the best site for the cutaneous opening of the

ureter is at a point about midway between the umbilicus and anterior superior spine of the ilium. The ureter is exposed by using the iliac (Fig 738) incision described above and divided between two ligatures as close to the bladder as possible. The proximal portion is mobilized as high as possible and brought out through the upper third of the iliac incision used to expose the ureter. Cabot (Jour Urol, 1936, 35, 596) has suggested that the ureter and catheter which has been placed in the lumen, should be brought out obliquely through the abdominal wall. We believe this to be an excellent way of avoiding kinking of the ureter. The distal end of the ureter should project an inch beyond the

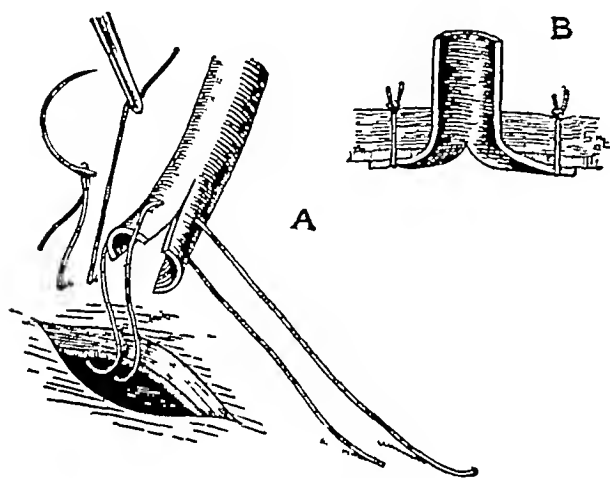


FIG 743—A simple method for reimplantation of the ureter into the bladder

A Cut end of ureter split and catgut sutures introduced into the two flaps. Note how latter are pulled into lumen by a suture on each side of bladder incision.

B Sutures tied on outer aspect of bladder so that ureteral flaps are held firmly against bladder wall.

skin in order to allow for retraction following sloughing of this distal portion.

Implantation of the Ureter Into the Bladder

This operation, termed "ureteroneocystostomy," is indicated in operative injuries of the ureter, as described in Chapter 30. In recent cases it presents less technical difficulty than in late ones. In the latter, the lower end of the ureter is usually found imbedded in cicatricial tissue to such an extent that its implantation into the bladder is impossible.

Ureteroneocystostomy has also been used in nontraumatic strictures of the pelvic portion of the ureter, but here also it is extremely difficult in most cases to mobilize the ureter at a sufficiently low level to implant it into the bladder.

The technic first described by Sampson (Fig 743) is the simplest. The ureter is sectioned transversely at as low a level as possible and then incised longitudinally (A of Fig 743) for a distance of 0.5 cm (about one-fourth of an inch). A

plain fine (0 or 00 size) catgut suture is inserted through each lateral flap. The ends of the two sutures are then passed through the entire thickness of the bladder on either side of an opening made as low as possible in the latter. The sectioned end of the proximal portion of the ureter is next drawn into the bladder opening and the two flaps (B of Fig 743) held firmly in contact with the mucosa, while the respective sutures are tied on the outside of the bladder.

Implantation of the Ureters Into the Intact Intestinal Tract

More than sixty techniques,¹⁰ many of which are modifications of an original principle have been published by about fifty surgeons. It would seem that every surgical principle has been utilized. Of all of these the submucosal has a distinct advantage in theory and has shown the best results in practice. Nearly all modern techniques make use of it as the primary or secondary principle. The marked difference between the risk of implantation for exstrophy (less than 15 per cent) and for cancer (less than 30 per cent) arises partly from differences in the age period but chiefly from the added risk of the operation (total cystectomy) for the malignant condition. Implantation in two stages as done for most exstrophies, is safer as a rule than simultaneous bilateral implantations. The latter is the method used in malignancy because of the necessity for a second operation to remove the cancer.

Until the principle of the intact ureter operation as proposed by Higgins has been perfected so that a one stage operation can be done the implantation of the second ureter at the time of cystectomy is the safest plan. The theoretical advantage of extraperitoneal operations has not proved to be practical. Peritonitis results from leakage after operation and not from contamination during it. When sutures are placed properly leakage does not occur. The problem of the best method for implantation of the ureter into the intestine remains an un-

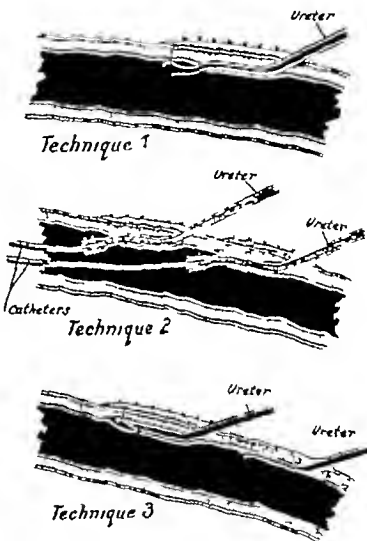


FIG. 744.—Diagram of the three Coffey techniques of implantation of the ureter into the intestine (Courtesy of the late Dr. R. C. Coffey and of the British Journal of Urology)

*We have quoted freely from the very thorough analytic study of the subject by Hinman and Weyrauch (loc cit)

solved one, not as the result of faulty technic but because of the indeterminate but ever-present factor of urinary sepsis. The first and second Coffey technics are more frequently employed at present than any other. We will describe their essential features.

Coffey Technic (Technic 1) An incision (Fig 744) is made like that employed for exposure of the pelvic portion of the ureter. The latter is divided between ligatures as close to its entrance into the bladder as possible.

The ureter is next (Fig 745) mobilized for a distance of 8 cm.

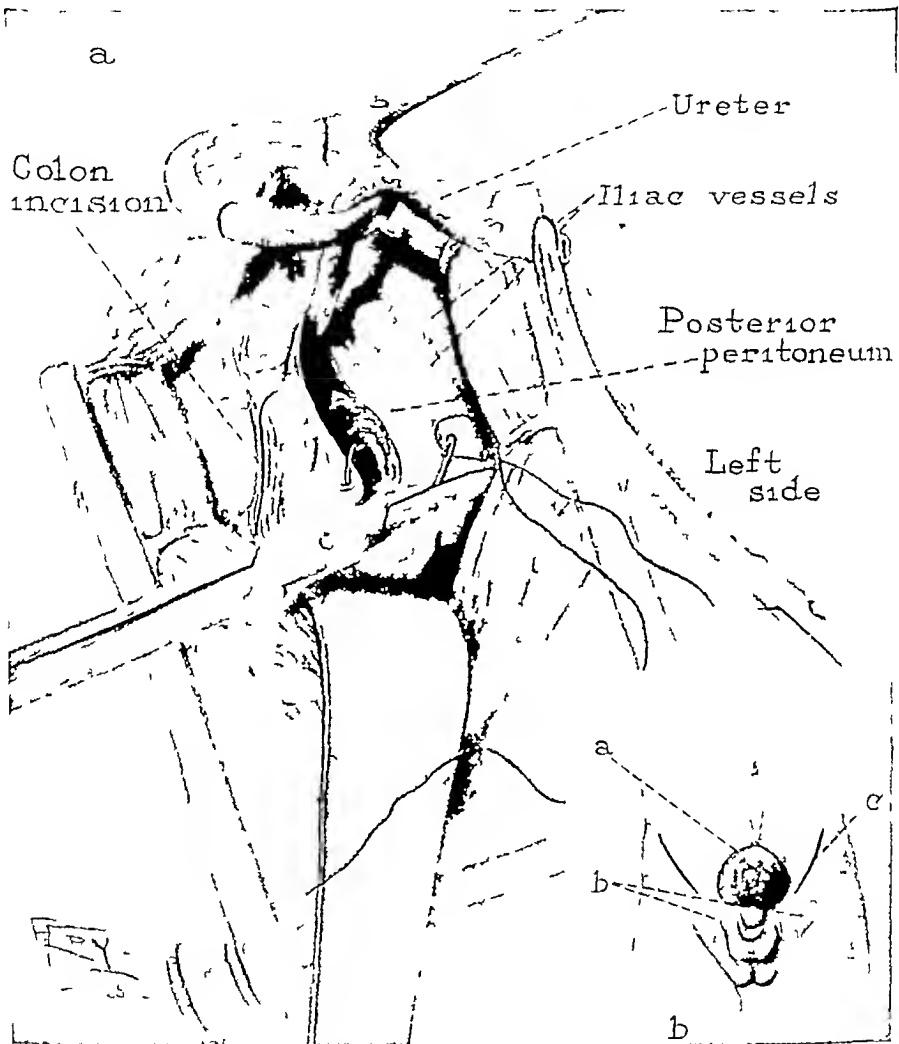


FIG 745—Chas H Mayo modification of Coffey technic No 1. A Ureter elevated from its bed and peritoneum being sutured to cover the raw areas. B Incisions for transplanting ureters. (Courtesy of the Mayo Clinic)

The implantation on the right side is made first, because of the mobility of the rectosigmoid and the convenience of bringing it to the right lower abdomen without first having transplanted the left side, which would cause tension and limitation of the segment of bowel to be used.

At a point opposite the mobilized ureter, an incision 6.5 cm long is made through the serous and muscular coats of the bowel down to the mucosa, to form a bed (Fig 745) in which the ureter is to rest longitudinally. At the lower or distal end of the incision, a puncture is made in the mucous membrane, large

enough to allow the passage of the ureter. A curved needle carrying No 0 cat gut is then passed through the open end and tied to the tip of the ureter. The curved needle is passed through the opening into the mucous membrane, to emerge 1.25 centimeters below the distal part of the incision in the bowel in the line of the longitudinal bands, drawing the thread with the ureter (Fig 746) into the lumen of the bowel. The thread is then fixed and tied in the fold of the intestinal serosa at the point of emergence.

Interrupted sutures approximate the divided peritoneum and muscles of the intestine over the ureter every other stitch catching a bit of the outer wall of

FIG. 747

FIG. 746

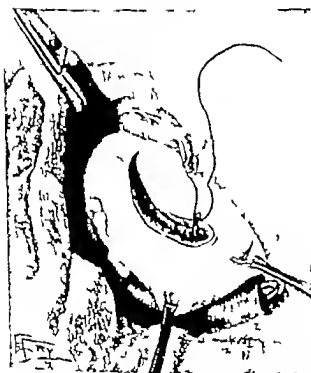


FIG 746—Chas. H. Mayo modification of the Coffey technic No 1. The ureter being drawn into the bowel by needle and thread. The thread is advanced into the ureter about 5 or 7.5 centimeters. (Courtesy of the Mayo Clinic.)

FIG. 747—Final step of Chas. H. Mayo modification of Coffey technic No 1. Closing the muscular coat and serosa of the recto-sigmoid over the ureter. (Courtesy of the Mayo Clinic.)

the ureter to fix its position in the longitudinal bed made for it. A continuous row of sutures gives additional protection over the line of the interrupted sutures (Fig 747). Two or three additional sutures fix the bowel to the parietal peritoneum to cover and avoid kinking of the ureter and to prevent any traction on it. By this method, the ureter is incorporated in the bowel wall for a distance of about 2.5 to 3.75 centimeters. Any internal pressure closes the ureter but does not prevent normal intermittent emptying of the ureter by peristalsis.

The second operation transplantation of the left ureter is carried out in from ten to fourteen days which permits sufficient time for the right transplanted ureter to function fully and makes allowance for the interval during which mild symptoms of pyelonephritis usually occur.

The most favorable age for the operation for exstrophy of the bladder, is between four and ten years. Older persons have been operated on successfully, but dilatation of the ureter is more common in them, and, if both ureters are dilated, operation is inadvisable. To determine the condition of the ureters before operation, it is sometimes advisable to employ excretory urography. By this means, information may be gained which would save unnecessary exploration if they are greatly enlarged.

The Mayo Modification of Technic 1 C. H. Mayo and W. A. Hendricks (*Surg. Gynec. and Obst.*, 1926, 43, 129) have modified the Coffey technic 1 as follows:

The lower end of the freed ureter is split for 0.6 centimeters. The short end of the catgut is guided into the open end of the ureter for a distance of about 5 to 6.25 centimeters, to insure the ureter's remaining patulous during the early days of edema following its transplantation.

Coffey Technic 2 (Fig. 744) A tube or ureteral catheter is fastened within the ureter by ligatures which both protect the ureter against intestinal infection and anchor it to the catheter, after which the latter is passed through an opening made in the mucosa at the caudal end of an incompletely intestinal incision. The catheter is used to draw the ureter into the submucosa and through the opening in the mucosa into the intestinal lumen. The urine is thus carried through the lumen of the catheter into a receptacle outside of the body. The anastomosis is completed and the open ureter exposed to intraintestinal pressure only after that portion of the ureter (Fig. 744) which protrudes into the intestinal lumen sloughs and permits the catheter to be expelled within eight to sixteen days after the operation.

Coffey Technic 3 (Fig. 744) The ureter is anchored in the submucosa by a suture which fastens the end of the ureter in the angle of the caudal end of an incompletely intestinal incision. The anastomosis is gradually made by the tightly tied suture which transfixes both the ureter and intestinal mucosa. The anastomosis is complete three or four days after the operation.

RELATIVE IMPORTANCE OF THE THREE TYPES OF TECHNIC according to Coffey (*Brit. Jour. Urol.* 1931, 3, 424) is:

Technic 1 was at first employed almost exclusively for cases of exstrophy of the bladder (Fig. 301) because of the fact that many of the ureters in children in such cases are too small to admit large-sized catheters. This technic 1 is still preferred by the majority of operators for cases in which it is inadvisable to transplant both ureters at the same sitting. In addition to its use in exstrophy of the bladder, it is now being employed for transplantation of the ureters in urinary fistulas incident to birth and operative trauma (See Chapter 45) as well as in total cystectomy for cancer (see Chapter 52).

Technic 2 has a greater field of application than technic 1. It can be used in simultaneous transplantation of both ureters at the same sitting, in transplantation of dilated ureters and in cases in which only one ureter is present as the result of a congenital solitary kidney (Figs. 179, 180 and 393) or following removal of the opposite kidney. This technic 2 cannot be used in cases of exstrophy of the bladder when the ureters will not admit No. 10 catheters. The objections to technic 2 in addition to the fact that it is not applicable to ureters of small caliber, as just stated, is that it requires special equipment which is not always available.

and also because it necessitates special postoperative care owing to the tendency of the catheters to become blocked Coffey always preferred the bilateral operation, i.e., at one sitting when technic 2 was used

Technic 3 (Fig 744) has the disadvantage that only one ureter at a time can be transplanted It has never achieved the popularity of technic 1 or 2 although Coffey (loc. cit) believed that it offered a great possibility when a ureter is severed or divided at operation as well as in extrophy of the bladder in new born or young children

Higgins Method

The use of the "intact ureter" for implantation into the intestine — As stated above the Coffey technic 3 (transfixion suture method) showed that a fistula could be established between the ureter and the intestine without opening into the latter during operation However as the ureter is divided at the time of implantation no urine can flow into the intestine for 48-72 hours, i.e. until the fistula is established

Higgins (Surg Gynec. and Obst 1933 57 359) described a method which combines the transfixion suture of Coffey with the principle of the intact ureter In the first stage an incision 6.5 cm in length is made in the rectosigmoid down to the mucosa. The ureter having been placed in the trough a transfixion suture of silk is first placed through the wall of the ureter piercing its lumen and then through the exposed submucosal mucosal layer of the rectal wall and tightly tied It may or may not be anchored on a rectal tube Higgins advises that it is essential for the suture to be placed at the distal end of the incision in order to obviate the formation of a blind pouch when the ureter is severed at the second stage The muscular and serous layers are reapproximated over the ureter with interrupted silk sutures. The site of implantation is finally extraperitonealized with a flap of posterior parietal peritoneum

At the second operation the ureters are isolated divided and ligated as closely as possible to their point of emergence from the distal angle of the incision and the end is buried in the wall of the bowel

The chief advantage is that the implantation can be done bilaterally at the same sitting without interruption of kidney function

CHAPTER 54

POSTOPERATIVE COMPLICATIONS IN UROLOGY

POSTOPERATIVE MORTALITY

COMPLICATIONS WHICH MAY FOLLOW ANY ABDOMINAL OPERATION

COMPLICATIONS ESPECIALLY APT TO OCCUR AFTER OPERATIONS ON THE URINARY TRACT

POSTOPERATIVE MORTALITY

Two recent studies of the causes of death after urological operations are of great interest. The first of these is by MacKenzie and Seng (Jour Urol, 1933, 29, 321) and is based on an analysis of 265 deaths of which 113 (42.5 per cent) came to necropsy. Their conclusions, based on the necropsy findings in 42.5 per cent and on the clinical observation in the balance of the 265 deaths were as follows:

Genito-urinary pathology of sufficient gravity to be the cause of death occurred in less than one-third of the 265 cases. Cardiovascular and respiratory pathology together are responsible for another third. Inflammatory pulmonary lesions constituted fully 10 per cent of the total number of causes of death. The influence of infection, even if mild, upon the cardiovascular and respiratory systems constitutes the "balance of power" between life and death. Nearly two-thirds of the deaths occur in surgical conditions of the kidney and prostate.

Hyman and Mencher (Jour Urol, 1935, 33, 315) feel that "any report of postoperative mortality not controlled by necropsies is of little value." This could be carried out in 119 or 70.8 per cent of 168 deaths following operation on the urinary tract. Grouped according to the organ operated upon, the 168 deaths followed operations on the kidney in 72, ureter, 6, bladder, 39, prostate, 35, urethra, 5 and 11 in cases which could not be assigned to any of these groups. Ninety-one deaths or 54.1 per cent were due to infection (wound, kidney, sepsis and peritonitis) and in 44 others, these four sources of infection were a contributing factor. Other causes of death were pneumonia and shock, each 6.5 per cent, cardiovascular disease, 5.9 per cent, pulmonary embolism, 5.3 per cent, hemorrhage, 4.1 per cent and cerebral conditions in 1.7 per cent. In 64 cases, uremia was found to be a contributing factor and secondary to an underlying condition of the urinary tract.

Complications following urological operations, as will be evident from a study of these causes of death, can be placed in two groups:

Group 1 Those which may follow any abdominal operation

Group 2 Those especially apt to occur after operations on the urogenital tract in the male and on the urinary tract in the female

GROUP 1 COMPLICATIONS WHICH MAY FOLLOW ANY ABDOMINAL OPERATION

1 Cerebral Complications. These are comparatively rare. They present the clinical picture of either a cerebral thrombosis, a hemorrhage or embolism in which the outstanding symptom is a hemiplegia.

2 Cardiac Complications.¹ These are especially frequent after operations on the prostate hence every patient above the age of fifty should be thoroughly examined before operation by an internist as to the condition of the cardiovascular system. Cases with high blood pressure, especially if there is little difference between the systolic and diastolic levels, who have a history of anginal pain and dyspnea on exertion form a group in which there is great danger postoperatively of coronary thrombosis with severe anginal attacks. A fatal outcome is frequent because so little can be done after such serious complications appear. Cases with low blood pressure and evidence of myocardial involvement are apt to develop acute cardiac dilatation and decompensation. Excellent results are obtained with digitalis and stimulants. The typical arrhythmias are not as serious complications as might appear at first glance. Showers of extrasystoles in an otherwise good myocardium, give a good prognosis, responding well to rest and sedatives. Auricular fibrillation is not an uncommon postoperative complication but as a rule is not a serious one although due to myocardial changes. For the treatment of both auricular fibrillation and of tachycardia, morphine in relatively large doses gives the best results. Heart block characterized by a slow pulse (below 50) is a serious postoperative complication. Absolute rest and digitalization offer the best outlook.

If a heart murmur is found during the pre-operative examination provided there is no evidence of decompensation it must not be regarded too seriously. The main problem is to ascertain the extent of myocardial changes. The indiscriminate use pre-operatively of digitalis is to be condemned. Every patient who is to undergo an operation on the urinary tract should be thoroughly examined radiographically and if necessary by electrocardiography. The presence of an old valvular lesion or of a wide aorta should lead to an evaluation of the risks of an operation. The poorest risks are patients with an antecedent coronary thrombosis.

3 Pulmonary Complications. These can occur after any type of anesthesia, including local. Upper respiratory tract infection at the time of operation is an important contributing cause hence any intervention should be avoided during such a period. The length of the anesthesia, dressings which constrict the upper abdomen and keeping the patient too long a time on the back, all play a part.

Bergh (Minn. Med. 1933 16 105) has recommended the use of inhalations composed of 10 per cent carbondioxide and 90 per cent oxygen for three minutes, three or four times a day as a prophylactic measure against atelectasis which in some degree is the most frequent postoperative pulmonary complication.

(A) BRONCHITIS recurrence of asthmatic attacks, broncho and lobar pneumonia do not need special mention because the diagnosis and treatment are the same as if they occurred independently of any operative intervention.

(B) MASSIVE COLLAPSE OF THE LUNG is an important and not uncommon postoperative complication due to blocking of a large bronchus by the excessive secretion incident to prolonged general anesthesia. In the majority of cases the onset is sudden in the form of pain in the chest accompanied by marked

¹We are indebted to Drs. D. L. Schram and Vance Rawson for the section on cardiac complications.

dyspnea and rapid pulse, resembling greatly the clinical picture of one of the types of pulmonary embolism (see later) There may be a moderate rise of temperature, but very little expectoration during the early stage There is a less common latent form in which the systemic symptoms overshadow the local ones, i e there is little dyspnea or pain In both forms, the average duration is two to three weeks It may terminate suddenly if the entire lung is reinflated, or gradually It is rarely fatal The chest appears flatter on the collapsed lung side and the respiratory movements are restricted On a plain film the heart

and mediastinum are seen to be drawn over toward the side upon which the collapsed lung is located Attempts have been made recently to relieve the condition by bronchoscopic aspiration of the mucus plug occluding the bronchus

(C) PULMONARY EMBOLISM This is one of the most dreaded postoperative complications and its incidence following prostatectomy is relatively high It is observed under one of two clinical pictures depending upon the importance, i e, size of the blocked pulmonary artery If this is a large vessel, the patient complains of severe pain in the chest, and dyspnea This is followed immediately by cyanosis, increasing rapidity and lack of volume of the pulse Death takes place within a few minutes after the onset According to some recent experimental work by Duval and associates, it is the sudden stimulation of the afferent fibers of the pulmonary nerves and the resultant shock which kills, rather than the cutting-off of the circulation by a large embolus

In the second clinical picture, there is also a sudden severe pain in the chest, more localized than in the fatal type It is also ac-

companied by symptoms of shock but much less intense, by moderate dyspnea and often followed by expectoration of blood-stained mucus On physical examination, a pleuritic friction sound is often heard over the area to which the pain is referred. In this second form of pulmonary embolism, the occluded vessel is a relatively small one and the area of hemorrhagic infarction relatively circumscribed The prognosis in this second type is favorable and following the use of morphine, applications of heat over the painful area and absolute quiet, the symptoms will subside within a week

Pulmonary embolism follows thrombosis either of veins in the immediate vicinity of the various procedures for removal of benign or malignant prostatic adenoma, bladder tumors, etc, or the thrombosis may take place in the femoral vein close to its junction with the saphenous The inflammatory changes in the vein wall are the primary and essential factor The wider, i e, the more



FIG 748—Drawing made at necropsy of an acute gastric dilatation Note how enormously dilated stomach displaced diaphragm upwards and small intestine downwards into true pelvis

extensive the attachment of the thrombus to the vein wall the less often does a portion become detached to form an embolus. The only known preventive measures against thrombosis and subsequent pulmonary embolism are (a) reduce infection to a minimum (b) give plenty of fluids before operation and within a reasonable time four to five days after operation (c) get the patient out of bed as early as possible and (d) encourage frequent changes of position.

4 Gastric Complications. Every house officer and nurse should be instructed not to give too large quantities of fluid by mouth during the first four or five days following any abdominal operation and to immediately report if the symptoms to be enumerated as characteristic of acute gastric (Fig 748) dilatation. There are two types of clinical pictures under which this complication, which may end fatally if not recognized presents.

(a) Those in which there is recurrent vomiting of large quantities of sour smelling brownish fluid.

(b) Those in which the symptoms of displacement of the thoracic viscera (heart and lungs) predominate.

We will consider these separately because in the majority of textbooks emphasis is only laid upon the first group and one receives the impression that cases of acute gastric dilatation with little or no vomiting either do not occur or are so rare as to deserve no mention.

(A) VOMITING. We have found that in about two-thirds of the cases the outstanding feature is the vomiting and in the remaining third, the dyspnea, rapid pulse, cyanosis etc. due to cardiac displacement, are the most prominent symptoms. Many a case has no doubt either been overlooked completely or recognized too late because the possibility of the occurrence of an acute gastric dilatation without emesis was not made clear to our house officers. They are often the first to be called when such a serious and not infrequently fatal complication appears like lightning from a clear sky.

Let us therefore give as much consideration to the less common of the types of acute gastric dilatation as to the more common one which we will describe here first.

(1) EMESIS THE PROMINENT FEATURE. Here a patient who has been apparently making an uneventful recovery, suddenly and apparently with but little effort vomits a relatively large quantity of brownish sour smelling fluid. At times the vomiting is of the projectile character i.e. it is expelled with considerable force and yet with but little effort, such as retching etc. After a short interval more often minutes than hours, the effortless vomiting recurs and one is astounded at the large quantity (often a pint at each time) which is expelled in spite of the fact that absolutely no fluid has been swallowed in the interval. This recurrent vomiting is as a rule accompanied by all of the symptoms of thoracic visceral displacement, to be mentioned in the next syndrome.

Objectively one finds a marked prominence of the upper half of the abdomen. The tympanic resonance elicited on light percussion extends upwards over the heart region where the normal area of dullness has disappeared almost completely and is replaced by a tympanic note. The latter is also evident over the lateral aspects of the thorax more so over the left than the right side.

(2) CYANOSIS, DYSPNEA, ETC THE OUTSTANDING FEATURE. In this second

group, there is little, if any, vomiting of the brownish sour liquid which is such a characteristic symptom of the first group. One's attention is attracted by the marked dyspnea, accompanied by a rapid, often almost imperceptible pulse, and cyanosis. At first glance, the picture appears to be that of some serious cardiac condition, such as acute dilatation. Examination of the abdomen and precordial area will soon, however, aid in directing attention to the stomach. The marked prominence of the upper half of the abdomen and the widespread degree of tympany, with decrease in the intensity of the heart tones, is of great importance in differentiating an acute gastric from an acute cardiac dilatation.

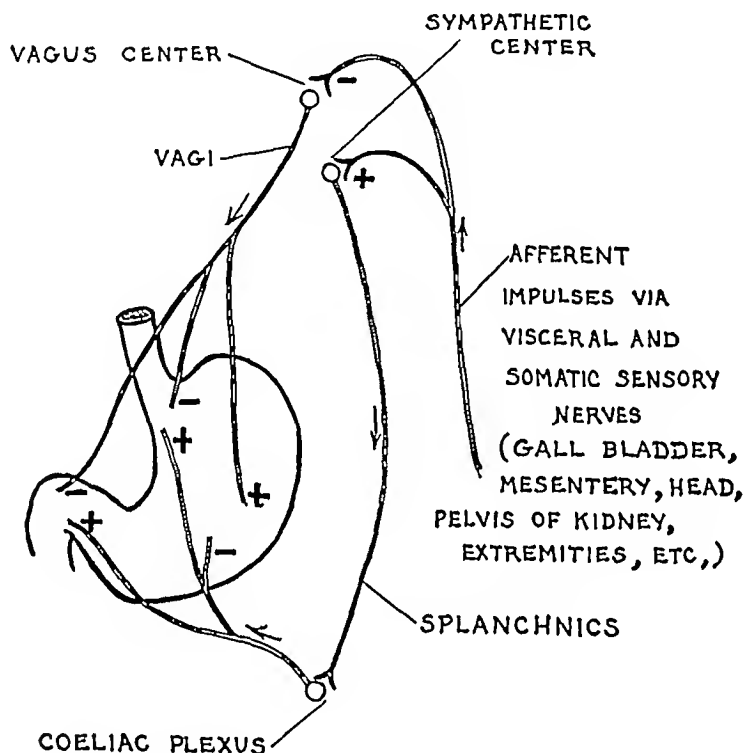


FIG 749—Diagram illustrating the pathway of nervous impulses resulting in reflex gastric dilatation from the stimulation of visceral or somatic sensory nerves. There are, of course, intercalated neurones connecting the sensory and motor nerves here shown. Reflex stimulation of the sympathetic center is accompanied by a simultaneous inhibition of the antagonist or vagus center, an example of the so called reciprocal innervation. (Courtesy of Drs Dragstedt, Montgomery, Ellis and Matthews.)

If there is the least doubt, the passage of a gastric tube or a Rehfuess tube will soon clear up the diagnosis.

As to the etiology of acute gastric dilatation, evidence has been presented by Lester R. Dragstedt and co-workers which offers a new interpretation. The dilatation is held to be due to reflex inhibition of the peripheral gastric motor mechanism through efferent impulses reaching the stomach by way of the vagus and splanchnics as shown in Fig 749. The dilatation of the atonic stomach is produced by swallowed air and the accumulating secretions of the stomach, pancreas, liver and upper duodenal mucosa. The cause of death is the failure of reabsorption of these juices and more particularly of the inorganic elements, sodium and chlorine, excreted in these fluids. The failure of reabsorption in turn depends upon the inability of the atonic stomach and duodenum to propel these secretions into the lower duodenum where their absorption can take place. In certain cases, a

secondary mesenteric obstruction to the horizontal portion of the duodenum occurs and provides a further obstacle to the passage of the secretions into the lower bowel.

TREATMENT OF ACUTE GASTRIC DILATATION This may be divided into (a) prophylactic and (b) curative

(A) **PROPHYLACTIC** We have found that an acute dilatation of the stomach is prone to occur in patients, who are very apprehensive and in those who have been allowed to take large quantities of fluid during the first forty-eight to seventy-two hours, after operation. This is by no means the rule, but one is astounded in some cases by the amount of fluid vomited or obtained upon lavage of the stomach, in spite of the fact that only a very small amount has been taken by mouth. One receives the impression that the stomach musculature is not only in a condition of acute atony and unable to propel its contents but that hypersecretion is an important factor. In some cases this constant filling up of the stomach persists, in spite of all therapeutic measures (see later) and results fatally.

From personal experience with a relatively large number of cases we believe that the ingestion of large quantities of fluid should be avoided especially those which are effervescent e.g. ginger ale etc., for the first three to four days after operation. We limit the intake by mouth to six ounces every four hours but do not begin with this amount until the second twenty-four hours if the anesthesia has been a general one. We also believe that giving opiates too freely plays a rôle in favoring the development of this complication and hence limit them as much as is feasible.

(B) **CURATIVE.** The sovereign method of relief is gastric lavage. Ordinary lukewarm tap water suffices and a large quantity should be at hand because one needs to continue the lavage until the fluid returns perfectly clear.

A gastric lavage in these cases should never be carried out with the patient in supine position i.e. lying on his back. The aspiration into the lungs of the large quantities of gastric fluid is a most potent danger and may result as the late Dr. E. Wyllys Andrews expressed it "In the drowning of the patient in his own vomitus."

We give the following instructions to our house officers:

- 1 Place patient on side with rubber sheet under head
- 2 Have an assistant hold wooden wedge between jaws so patient cannot bite fingers of person introducing tube and cannot obstruct the tube after fluid begins to escape
- 3 Sufficient rubber tubing must be added to the ordinary stomach tube to permit the funnel at the distal (outside) end to be easily brought down to a large basin placed on the floor alongside the patient's bed.
- 4 After having passed the tube into the stomach, allow as much of the contents to siphon out as possible before beginning the lavage. The latter should be continued until the fluid siphoned from the stomach is perfectly clear. We prefer to use the funnel and to siphon the contents of the stomach by gravity, rather than to attempt aspiration with the rubber bulb often attached to a gastric tube.

Every well regulated clinic must have the above equipment ready for immediate use in cases of acute gastric dilatation. If the symptoms enumerated under either of the above groups persist in spite of lavage the latter should either

be repeated at four hour intervals or, better still, we introduce the Kanavel modification of the Rehfuess tube and attach the outer end to the cheek with adhesive plaster, using a small bulb syringe to aspirate the gastric contents at ten or fifteen minute intervals

The duodenal tube can be passed through the nose and left in situ for weeks

One must constantly bear in mind that if the fluid continues, in spite of the above measures, to accumulate in the stomach, some form of ileus either adynamic or dynamic, may either be a complication or that the vomiting was not primarily due to an acute gastric dilatation, but simply an expression of a more distally located intestinal obstruction. Occasionally one encounters cases of primary uncomplicated acute gastric dilatation, which end fatally in spite of lavage and even

of gastrostomy or enterostomy

We have never employed the prone position as a therapeutic measure, but should recommend a trial, if lavage is of no benefit. Drugs have not been found to be of any avail

5 Intestinal Complications (a) Mechanical or septic ileus. These need not be considered, as a rule, after urologic operations, but occasionally, as in a recent case, an intestinal obstruction due to mechanical causes (band from previous gynecologic operation), must not be overlooked

(c) REFLEX, I E, ADYNAMIC ILEUS. There is such an intimate relation (Fig 750) between the nerve supply of the urinary and that of the gastrointestinal tracts, that it is not difficult to see how operations on the former, may be followed

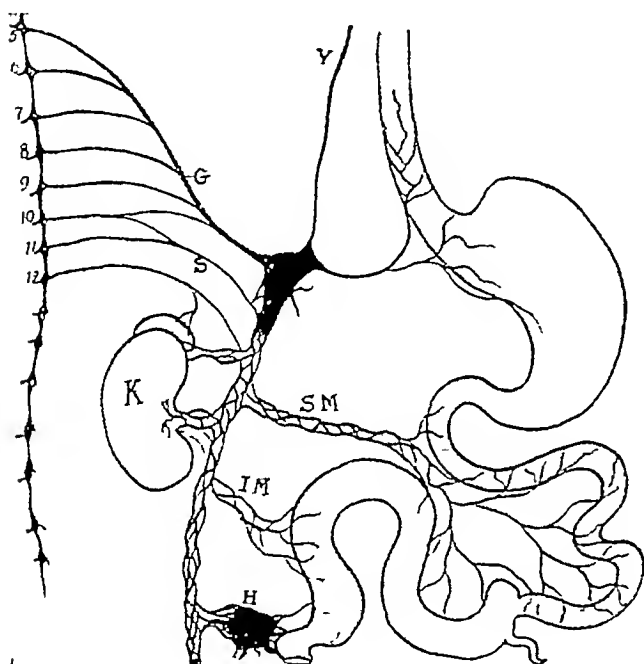


FIG 750—Diagram of relation of nerves of the kidney to those of the intestine (after Luciani) K, Kidney, V, vagus nerve to celiac ganglion, G, greater splanchnic nerve, S, smaller splanchnic nerve, SM, superior mesenteric plexus, IM, inferior mesenteric plexus, H, hypogastric plexus. Note how nerves of kidney and ureter communicate in celiac ganglion with those of stomach and intestine

by reflex paresis of the musculature, especially of the stomach and intestine. This complication, resulting in marked abdominal distention and other signs of ileus, occurs relatively oftener after operations on the kidney and ureter, than after those on the lower urinary tract

The clinical picture closely resembles that of the early stages of a mechanical ileus and one must not overlook the possible occurrences of such a true form of intestinal obstruction. The most striking feature is the abdominal distention and the inability to obtain the passage of either flatus or feces. The only prophylactic measures we know of, are to give as little morphin as possible, and to pass the rectal tube frequently, especially after operations on the upper urinary tract. If this is ineffectual, we give a milk and molasses enema or one ampule of "pitressin" every four hours for three doses. If these are all unsuccessful, one must not

delay too long before a cecostomy is done. Since we have instructed our assistants and nursing personnel regarding the possible occurrence of acute gastric dilatation and reflex ileus, we encounter these far less often than in former days.

6. Peritonitis. This needs seldom to be considered as a complication of urologic operations but has been reported after transurethral resection.

7. Postoperative Shock. The outstanding characteristic of shock is the low arterial pressure. The theory that this is due to absorption of metabolic toxins from the traumatized area is being discarded in favor of the theory that shock is caused by the local loss of blood and/or plasma resulting in a marked decrease in the volume of the circulating blood. This is accompanied according to Moon (Arch. Path., 1936, 22: 325) by decreased cardiac output and hemoconcentration. When the shock syndrome is fully developed, lowered blood pressure, diminished renal excretion and increased cardiac rate are associated features. Shock is simulated clinically by hemorrhage, syncope and rapidly developing cardiac failure.

The syndrome, pallor, rapid thready pulse, cold clammy skin and low blood pressure is found in both postoperative shock and hemorrhage; hence their differentiation is practically impossible unless one knows that very little bleeding occurred during the operation and the absence of any staining of the dressing shows that the syndrome is not due to a decrease in blood volume.

It is of the utmost importance to exclude this latter factor as the cause of the syndrome because to administer large quantities of fluid in the presence of persisting bleeding would only raise the blood pressure and increase the bleeding. It appears that certain nervous influences are of importance in the etiology of shock. There is the possible inhibition of vasoconstrictors and stimulation of vasodilators in acute circulatory collapse and what is even more likely a prolonged activity of the sympathetic system according to Cannon (Ann. Surg., 1934, 100: 704).

If unusual loss of blood during and after operation has been excluded, the patient who presents the above syndrome should be kept as warm as possible, best of all between warm blankets and under a wire cradle with several electric bulbs covered by blankets. We prefer to give a 5 per cent glucose-normal saline solution by the continuous drip method per rectum. If the patient has been grouped before operation, a transfusion should be given as soon as possible. Morphine and ephedrine are indicated, the former as a sedative, the latter as a vasoconstrictor.

8. Postoperative Hiccup. This is most apt to present between the first and seventh day after operation according to C. W. Mayo (Surg., Gynec. and Obst., 1932, 55: 701) although he reports a 16 day hiccup following prostatic massage. The hiccup may be a symptom of renal insufficiency or it may occur without any demonstrable cause. In the indeterminate cause group the treatment can only be symptomatic and should include opiates, barbiturates and the inhalation of a mixture containing carbon dioxide 5 to 10 per cent mixed with oxygen. The last named method has been very successful in some cases. We have been able to control this distressing postoperative complication at times by giving 250-300 cc. of a 10 per cent glucose solution intravenously.

9. Diabetes as a Postoperative Complication. The urologist is apt to

overlook the fact that a latent diabetes may play an important part in the healing of an incision or that a diabetic coma may supervene following operations on the kidney and ureter

Diabetes should always be suspected if gangrene of the tissues or an extremely rapid spread of infection is observed postoperatively. Even if glycosuria is absent, a blood sugar estimation may clear up the diagnosis. If recognized before operation, the patient should be placed under the care of an internist and operative intervention postponed until the diabetes is under complete control.

GROUP 2 COMPLICATIONS ESPECIALLY APT TO OCCUR AFTER OPERATIONS ON THE URINARY TRACT

The high incidence of complications following operative procedures on the urinary tract is due to the following conditions

- 1 The kidneys play the most important part in the elimination of nitrogenous waste products, whose retention as the result of long standing renal dysfunction, is reflected on other structures, so that patients who are carriers of such kidneys, are poor operative risks

- 2 The defensive mechanism of the urinary tract against infection plays a very important part in neutralizing toxins as fast as they are produced according to Cumming (*Jour Urol* 1936, 35, 540). The tissues immediately adjacent to the various components of the urinary tract are less well provided with a defensive mechanism. The result is that when infected urine escapes into the tissues around the urethra, bladder, ureter and kidney, there is a rapid absorption of toxins and bacterial growth is but little interfered with. This is not only true of the cellular tissue immediately adjacent to the various components of the urinary tract, but also of the various structures of the abdominal wall which it is necessary to traverse before reaching, for example, the bladder, ureter and kidney.

One only needs to analyze the reports of MacKenzie and Seng (*loc cit*) and of Hyman and Mencher (*loc cit*) as to causes of death following urological operations to realize the importance of the two factors: poor functioning kidneys and lack of resistance to infection on the part of structures adjacent to the urinary tract in the incidence of postoperative complications. Uremia was the chief cause of death in 30 per cent and infection, the chief cause in 10 per cent, of the 268 cases analyzed by MacKenzie and Seng. In the series of 168 cases, studied by Hyman and Mencher, the following table will give an idea of the importance of these same two factors, uremia and infection.

- 1 **Kidney** Of 72 deaths following operative procedures, the cause of death was infection in 56.3 per cent. There were at least 30 patients who died with uremic manifestations, 16 of them entering the hospital in uremia. The principal factor in the causation of the uremia was infection. Postoperative shock accounted for the death of four patients, pulmonary embolism for five, hemorrhage for five and peritonitis for five deaths, respectively. The last named cause emphasizes the importance of careful inspection of the operative field at the conclusion of the operation.

2. Ureter 6 postoperative deaths Over 60 per cent of the ureter group died of infection originating in either the wound or in the urinary tract
3. Bladder 39 postoperative deaths 25 or over 64 per cent died as the result of infection originating in the wound or in the urinary tract The mortality in the tumor cases was unusually high
4. Prostate 35 postoperative deaths In this group probably more than in any other the general condition of the patient plays an important role Most of these patients are in the sixth and seventh decades of life and have in addition, either myocarditis generalized atherosclerosis or diabetes Whereas in 45 per cent of the cases infection in one form or another was the important factor in the cause of death, the cardiovascular system and pneumonia accounted for an equal number of deaths Fifteen of the 35 patients died following ordinary suprapubic cystotomy
5. Urethral Stricture There were 5 postoperative deaths The causes of death were pneumonia infected kidney generalized sepsis each one and cerebral causes, 2 cases

PRE-OPERATIVE CAUTIONS

It is evident after a study of the preceding statistics that a fairly large proportion of deaths following urological procedures are due to the effects of infection and of back pressure Many of these complications are unavoidable when one takes into consideration the condition of the patient when first seen by the urologist. There are however a certain number of complications whose gravity can be considerably attenuated by attention to certain precautions which we simply attempt to enumerate, in as much as the majority have been discussed in preceding chapters

- 1 Good Risk Never to operate until a thorough physical examination has been made by an internist and the patient pronounced a good risk so far as any extra urinary pathology is concerned This examination must also keep in mind the possible existence of a latent diabetes

2. A coexistent nephritis whether of infectious origin or not, must be eliminated as far as is possible to do so by appropriate treatment. Any dehydration must be immediately corrected The work of Maddock and Collier (Jour Amer Med Ass'n 1937 108 1) has shown that a dehydrated patient weighing 60 kg needs a total of 7,100 cc per 24 hours of which 2 000 cc is for evaporation 1 500 cc. of urinary excretion and 3 600 cc. to restore depleted fluids. Serious dehydration symptoms appear when an amount of water equal to 6 per cent of the body weight has been lost The intravenous use of 5 per cent glucose in distilled water is one of the best ways to give fluids

- 3 A badly infected kidney should be given drainage preliminary to an operation by nephrostomy or indwelling ureteral catheter In the case of an infected bladder if an indwelling urethral catheter does not clear up the infection suprapubic drainage should not be postponed until it is too late to be of any help

- 4 Wound infection as shown above plays an important part in the causes of mortality The dissemination of infection over exposed wound surfaces incident to urological operations must be constantly borne in mind and ample drainage for all dependent portions where pus can accumulate It has been our custom to

drain every layer of the abdominal walls in badly infected kidney cases and to provide drainage by means of rubber tube for the perivesical tissues in suprapubic cystotomy That infection by *Bacillus welchii* (*Clostridium welchii*, *Bacillus perfringens* or gas-gangrene bacillus) can take place in urologic operations is shown by the fact that Turner (*Urol and Cut Rev*, 1934, 38, 153) found 15 reported cases and added two of his own

4 Perfect hemostasis must have been secured before any kidney is replaced following an operative procedure One can never take a chance that bleeding from an organ as vascular as the kidney will cease spontaneously An overlooked torn polar vessel must be immediately looked for and ligated

Every patient's blood should be grouped, if possible, before operation, so that a suitable donor can be found if transfusion becomes necessary To give a transfusion without attempting to control postoperative bleeding is to add fuel to the fire

INDEX

A

- Abscess, intraurethral, gonorrheal, 184
 of prostate gland, 303
 treatment of 211
 of scrotum, 425
 paranephritic, *see* Abscess, perinephritic
 pelvic, extension along sheath of vas deferens, 374
 in male, as complication of acute seminal encephalitis, 343
 perinephritic, 718
 acute, clinical picture 719
 typical cases, 720
 typical cases, 719
 differential diagnosis of 721
 age incidence of 719
 bacteriology of 719
 diagnosis of 720
 plain radiography 720
 urography excretory or retrograde 720
 due to transcapular rupture of the kidney 716
 locations of 718
 sex incidence of, 719
 treatment of, 722
 perinephritic, diagrams showing contrast locations of 184
 in gonorrhea, 183
 prostatic, in gonorrhea, 179
 Acid base equilibrium, renal regulation of 62
 Actinomycosis, of kidney 631
 Adenitis, inguinal, 270
 chronic, 270
 tuberculous, 270
 gonorrheal, 270
 female 242
 in chancroid, 263
 in chlamydia, 270
 in gonorrhea, treatment of 213
 in Hodgkin disease 270
 treatment of 271
 Adenocarcinoma, alveolar of kidney 777
 embryonal, of testes, 421
 papillary, of kidney 777
 in children, 862
 Adenomatous, embryonal, of kidney 77
 in children, 862
 Adrenal cortex, in situation of precocious sexual development, 433
 Adrenal glands, in relation to kidney during embryologic development, 6
 tumors of 797
 of cortex, diagnosis of 798
 differential diagnoses from Cushing syndrome 798
 treatment of 799
 with regard to condition of opposite adrenal 800
 of medulla, 797
 symplocytoma 798
 neurocytoma, 797
 paraganglioma, 798
 symplocytoma (neuroblastoma) 797
 symplocytoma of 798
 of hyperactivity of medullary portion, 798
 of hypoactivity of medullary portion, 798
 postpubertal, 798
 prepubertal 798
 treatment of tumor for simultaneous exposure of adrenals, 800
 Adrenogenital syndrome *see* Pseudohermaphroditism, female
 Aerolavin, in treatment of psoriasis, 710
 Air embolism, fatal, following pneumocystography 129
 Albuminuria, 802
 benign, 802
 functional, 802
 orthostatic, 802
 significance of 802
 Alcoholism, chronic, as cause of sterility 440
 Alkylol, 10 11
 Alpecia, syphilitic, 248
 Alpha methylnic tablets 149
 American scale 72
 Ammonium chloride, treatment of pyelonephritis, 710
 Anesthetics, in treatment of gonorrhea in children, 867
 Anamnesis, *see* History of patient
 Anatomy of genito-urinary tract, 16
 Androgen 431
 Androin, 67
 relation to cholesterol, 431
 Anesthetics, 147
 block, 150
 caudal 152
 combined local and general, advantages of 148
 epidural 152
 general considerations, 147
 general anesthesia, 148
 cyclopropane 148
 ethylene 148
 May II intratracheal tube for 148
 nitrous oxide 149
 infiltration 149
 intra-cranial, 154
 methods of 147
 paravertebral indications for 151
 peridural 152
 preliminary medication in, 148
 regional, 151
 sacral, technique of 152
 spinal 152
 danger of 153
 solution used for 153
 surface (meninges membrane) 149
 syringe 149
 Anesthesia, following perforation of anal renal cin by calculus 734
 Anopheles, excretory system of 3
 Anorectal region, chancre of 252
 A testis S in treatment of impotence 445
 Anuria, 876
 as complication of urography 119
 calculus, treatment of 879
 causes of 876
 excretory 877
 obstructive group 877
 prerenal 876
 renal, 877
 secretory group 876
 clinical pictures in, 877
 in period of partial intolerance 878
 in period of tolerance or symptomatic period, 877
 in stage of acute renal or complete intolerance, 878
 definition of 156
 diagnosis of 878
 clinical history 878
 urography 878
 in calculus, 55
 renal calculi treatment of 764
 reflex 63
 temporary in inflex of the kidney 636
 treatment of 878
 forced diuresis, 879
 causes of secretory origin, 879
 obstructive type, 879
 Aortography 114
 hematuria in, 881
 Appendicitis, acute differentiation from acute ureteral block, 573
 Appendix testis of Morgagni 9
 Arthralgia, gonorrheal 197
 Arthritis, gonorrheal 196
 acute, 196
 chronic, 197
 treatment of 213
 aspiration, 214
 counter-irritation, 214
 diathermy 214
 focal 213
 foreign proteins, 214
 hand injections, 213
 ichthyol ointment, 214
 immobilization of joint, 214
 local, 214
 massage of prostate 213
 systemic 214

Arthritis—(Continued)
treatment of—(Continued)
vaccines, 214
vasotomy, 213, 372
vesiculectomy, 214

Artificial impregnation, 943

Aspermia, 435

Asthenospermia, 436

Autonephrectomy, in tuberculosis of the kidney 729

Autoserotherapy, in gonorrhea, 208

Azo dyes, in treatment of pyelonephritis, 710

Azoospermia, 435
congenital 435
physiologic, 435
temporary, 435

B

Bacillus aerogenes (aerobacter) differentiation from
Bacillus coli (*Escherichia*) by Voges
Proskauer reaction 689

Bacterial calculi, 748

Bacteriophage, in treatment of pyelonephritis, 712

Bacteruria, 699
definition of, 156
tuberculous 741
criteria for diagnosis of, 741

Balanitis, erosive 269
gangrenous, 269

Balanoposthitis 289
differential diagnosis of, 290
from chancre 255
from gonorrhea 185

Barium sulphate solution as contrast medium for
cystography, 127

Bartholinitis, gonorrheal, 243

Bartholin's glands 14
gonorrhea of, latent, 241

Bas fond " see Retrotrigonal fossa

Beck's operation for hypospadias 907

Betaoxybutyric acid, in treatment of pyelonephritis
709

Benique scale 72

Bilharziosis, 476

Bladder absence of complete, 451

absorption from 65
anatomy of 36
cystographic study of 36
anomalies of 451

aplasia of 451
arteries of 40
automatic following spinal cord injury, 530
base of 37

blood supply of, 40

calculi of, 492
calcium 497
cholesterin, 497
coincidence with renal, ureteral and urethral
calculi 750

complications from 497
cystin 497
relation to cystinuria 494

diagnosis of 498
cystoscopy in 498
radiography in 499
stone searcher for 499
etiology of bacteria and stasis in 493
biochemical factors in 493
etiology of, dietary factors 494
hereditary factors 495
metabolic disturbances 494
vitamin A deficiency 494

fibrin 497
formation of theories of, 492
hematuria in 884

indigo 497
location 496
number of 495
oxalate 497
phosphate 497
primary 492
removal of surgical, 966
secondary 492
size 495
symptoms of 497
hematuria of, 498
masked 497
pain, 497

Bladder—(Continued)

calculi of—(Continued)

symptoms of—(Continued)

pathognomonic, 497
prolapse of rectum 498
urinary disturbances 497

treatment of, 500

litholapaxy 500
contraindications to, 501
recurrences following, 502

technic of, 501

suprapubic cystostomy, 501
recurrences following, 502

urate, 496

varieties of 496

weight, 495

capacity of, 37

carcinoma of, treatment of, radium 962
implantation of emanation seeds in, 963
method of implanting seeds, 963
method of removing seeds 964
removable seeds 963

cellules or false diverticula of, 481

detrusor of 38, 39

development of 11

diversion of urine from, operation for, 1015

diverticula of, 481

acquired 482

age incidence of, 482

complications of, 484

calculi 485

hemorrhage, 485

incident to relation of sac to ureter, 485

neoplasms, 485

obstruction at the vesical outlet or in the
urethra, 486

rare, 487

definition of, 481

diagnosis of 487

cystography and contrast cystography, 488

cystoscopy 487

passage of opaque ureteral catheter, 489

plain radiography, 488

false, 481

forms of 481

infection of, 484

location of, 482

number of, 482

origin of, 481

congenital, 481

radiography of, 129

sex incidence, 482

size of, 481

surgical treatment of combined intra and extra
vesical diverticulectomy 953

diverticulectomy technic of 953

Young's technic for 952

symptoms of 487

treatment of 489

surgical, indications for 489

true 481

diverticulitis of, 484

double 451

complete, 451

incomplete, 451

embryology of, 11

endometriosis of 516

evacuation of, 65

training of, as preventive of enuresis, 870

examination of cystoscopic 109

in obstruction of the bladder neck, technic of 329

extrophy of clinical aspect of, 453

complete 451

in male 452

complications of 452

carcinoma 452

intestinal 453

of upper urinary tract 453

epispadias associated with, 907

etiology of, 453

in female, 451

in male 451

incomplete cases 451

operation for, optimum age for 1020

treatment of 454

with complete epispadias 452

female, effects of parturition upon, 826

infections of, 824

diagnosis of 827

non specific 824

chronic interstitial cystitis 825 827

pathology of 825

predisposing causes of, 824

Bladder—(Cont. used)

- atresia of 478
- ectrocervical, 479
- symptoms of 479
- treatment of 479
- umbilical, acquired, 454
- congenital 454
- location of, 39
- foreign bodies in, 502
- diagnosis of 503
- necrosis of 503
- nodes of entrance of 502
- removal of surgical, 966
- symptoms of 503
- treatment of 503
- form of, 37
- hernia of 490
- age incidence of 491
- definition of, 490
- diagnosis of 491
- etiology of, 491
- herald ring involved, 491
- intraperitoneal, 491
- sex incidence of, 491
- symptoms of 491
- treatment of 491
- anastomosis of, 490
- extraperitoneal, 491
- paraperitoneal, 490
- hypertrophy of musculature of intracyclic pressure curves in, 527
- infections of resistance to, 65
- infections of, see also Cystitis
- injuries to, 455
- see also Bladder wounds of
- prostration during instrumentation, 456
- treatment of 460
- inversion of, 41
- hypogastric or sympathetic, 41
- pelvic or para sympathetic, 42
- usage of denervation of 41
- lymphatics of, 41
- muscle of cystoscopic aspect of 109
- musculature of 37
- detrusor 38
- external sphincter 39
- internal sphincter 29
- Mercer in 38
- trigone, 38
- urethral orifice, 39
- wall, 37
- neck of 39
- neurogenic, 519
- neurogenic dysfunction of cystometrie deviations indicative of 528
- diagnosis of 522
- by catheter 523
- cystometrie, 525
- cystoscopy 524
- radiography 523
- etiology of 519
- abdominopelvic resection for carcinoma, 52
- cerebral lesions, 520
- cerebrospinal lesions, 519
- diabetes, 522
- drugs, 521
- polysymptomatic, 522
- prostatectomy 521
- spinal cord injuries, 519
- spinal cord irritation by tumors or bone impingement, 520
- tabes, 520
- hypertonic, 523
- intracyclic pressure in, 526
- hypotonic, 523
- intracyclic pressure in 526
- in children, 524
- in open fields, 522
- normalization of pathologic conditions, 527
- symptoms of 519
- treatment of, 526
- continuous bladder irrigation, 531
- drugs, 531
- drugs, antispasmodic, 531
- detrusor depressants, 531
- detrusor stimulants, 531
- ergotamine tartrate, 531
- mecholyl 531
- potassium acetate, 531
- strychnine 531
- rectal stimulation, 530
- cystostomy 532

Bladder—(Cont. used)

- neurogenic dysfunction of—(Cont. used)
- treatment of—(Cont. used)
- rigid 532
- presterile neurectomy 532
- resection of posterior vesical lip, 532
- surgical vesicostomy, 532
- status of follow-up cystometrograms in 529
- varieties of 522
- with concomitant incontinence, palliative measures in, 531
- operation on, 948
- diathermy 953
- division of lips of urethral orifice 966
- electrocoagulation, indication for 965
- mortality from infection 1030
- removal of foreign bodies and small calculi, 966
- resection of the bladder 954
- suprapubic cystostomy 948
- total cystectomy for cancer 957
- transurethral procedures, 965
- fulguration, 965
- peridiverticulitis of 484
- peritoneal covering of 39
- physiology of 64
- position of 37
- in children, 37
- in females, 37
- pressure in, 65
- tracystic 525
- in hypertrophy of the bladder musculature 527
- in hypotonic bladder, 526
- measurement of 523
- see also Cystometry
- normal, 523
- psychic influences, 527
- radiography of 126
- regenerative capacity of 66
- relations to other parts, 39
- resection of 954
- indications for 955
- technic of 955
- Retzius space of 40
- rupture of 457
- by subperitoneal or subcutaneous injury 457
- diagnosis of catheterization, 458
- in lat. cases, 460
- Vaughan Rodnick at test, 459
- etiology and mechanism of 457
- extraperitoneal diagnosis of, excretoryography 459
- intraperitoneal, 457
- spontaneous, 461
- etiology of 461
- symptoms of 458
- in early cases, 458
- in late cases, 460
- pyelitis of 476
- trigone of 38
- cystoscopic aspect of 109
- tuberculosis of children, 861
- tumors of 504
- angioma 510
- carcinoma, 509
- at base of bladder and urethral orifices, treatment of, 518
- infiltrating, differential diagnosis of from simple papilloma and papillary carcinoma 514
- treatment of, 518
- chondroma, 510
- death from cause of 512
- dermoid cyst and teratoma, 510
- diagnosis of 512
- cystography 516
- cystoscopy 515
- examination of abdominal and pelvic organs for primary growths 513
- general examination of, 515
- ureterocystography of, 515
- urethroscopy and cystoscopy 513
- differential diagnosis of from edema bulbosum 515
- grade 4 infiltrating tumors, 514
- epithelial, differentiation of 514
- extensive single or multiple infiltrating types, treatment of 518
- fibroma, 510
- diagnosis of cystoscopy 515
- hematuria in, 854
- inflammation in, treatment of 516
- malignant, in children, 863
- metastatic from, regional and generalized, 511
- myoma, 510
- myxoma, 510

Bladder—(Continued)

- tumors of—(Continued)
 - papillary carcinoma 508
 - differentiation from simple papilloma and in filtrating carcinoma, 514
 - treatment of 518
 - papilloma 506
 - cystoscopic diagnosis of 514
 - differential diagnosis of, from papillary carcinoma 514
 - treatment of, 518
 - primary 506
 - recurrent treatment of, 518
 - rhabdomyoma 510
 - secondary 510
 - of extrurinary origin 510
 - of urinary tract origin, 510
 - spread of 511
 - symptoms of 512
 - hematuria 512
 - pain 512
 - urination disturbances 513
 - treatment of 516
 - cystectomy total 518
 - diathermy transvesical 517
 - iliac ureterostomy indications for 518
 - radium in 517
 - roentgenotherapy, 517
 - surgical, 517
 - transvesical diathermy, 960
 - anesthesia for 962
 - in pedunculated tumors 962
 - in tumors protruding into vesical cavity, 962
 - in very fleshy tumors 962
 - ulcer of due to irradiation of uterus, 839
 - hematuria in 884
 - vertex of 37
 - wall of 37
 - wounds of 455
 - penetrating diagnosis of 456
 - pathologic anatomy of 455
 - symptoms of 456
 - treatment of 456
 - with perforation of only extraperitoneal portion of 455
- Bladder neck contractures of 317
- congenital 349
 - fibrosis and inflammation 317
 - in median bar formation, 317
 - pure fibroses 317
- obstruction of clinical stages of 322
- period of acute or chronic retention 321
 - period of increased desire to urinate 322
- diagnosis of 325
- clinical history 326
 - cystography or radioscopy of bladder in 330
 - examination of abdomen 329
 - examination of urethra and bladder in 329
 - radiography 328
 - rectal palpation 328
 - routine of examination for 327
 - blood 327
 - cardiovascular apparatus 327
 - central nervous system 327
 - general condition 327
 - genito urinary tract 328
 - quantity of fluid ingested vs quantity excreted 327
 - urethrocystoscopy 330
 - urologic study, 326
- effects of 319
- local 319
 - infection 319
 - on genitalia 321
 - upon bladder wall 319
 - systemic 321
 - dehydration 322
 - on blood and body tissues 321
 - on cardiovascular system 322
 - upon ureters renal pelvis and kidneys 321
- urosepsis 322
- emergency cases 325
 - in female, treatment of 829
 - pathology of, 309
 - surgical treatment of intra urethral instrumentation 922
 - intra urethral instrumentation Braasch Bumpus Thompson punch 922
 - intra urethral instrumentation rectoscope 922
 - symptoms of hematuria as initial symptom 323
 - in relation to degree of obstruction 324
 - transurethral resection of the prostate for advanced stages of 923
 - in multiple stages advantages of 923

Bladder neck—(Continued)

- obstruction of—(Continued)
 - vs hypertrophy of the prostate 308
 - treatment of in cases of election 334
 - in cases of election in presence or absence of complicating diabetes 335
 - with cardiovascular conditions 336
 - with major degree of retention 337
 - with minor degree of retention, 337
 - without retention 335
 - general measures 335
 - local measures 335
 - in emergency cases 332
 - during attack of acute retention 332
 - in presence of massive hemorrhage into the bladder 334
 - in presence of severe cystitis complicated by pyelonephritis 334
 - trigonal and interureteric ligament hypertrophy 318
- Blood creatinin in as renal function test 140
- nonprotein nitrogen in as renal function test 140
- urea content as index to nitrogen retention 140
- Block anesthesia 150
- Bogros space 58 373
 - abscess of 374
- Bottle operation for hydrocele 420
- Bougies, bulbous, 77
 - follow up 78
 - scales for 72
 - silk woven 77
 - urethral 77
 - varieties of 77
 - whalebone filiform, 77
- Bowman's capsule, development of 6
- Bowman's theory of filtration and concentration of urine, 61
- Brain as affected by urologic surgery 1022
- edema of, in glomerulonephritis treatment of 806
- Bright's disease arteriosclerotic 810
 - benign nephrosclerosis 811
 - malignant nephrosclerosis 810
 - senile arteriosclerotic kidney 811
- Bright's disease *see also* Nephritis
- Bronchitis as complication of urologic surgery, 1023
- Bubo *see also* Adenitis inguinal
 - chancreoid 263
 - chronic secondary to tumor 271
 - suppurative in gonorrhea, 271
 - syphilitic 256 270
- Buck's fascia 44
- Bud ureteral *see* Ureteral bud
- Buerger cystourethroscope 102
- Bulbourethral glands, *see* Cowper's glands
- Bursitis, gonococcal, 197

C

- Calcium carbonate calculi 747
- Calculi *see* names of regions involved
- renal *see* names of organs and regions
- Carbol fuchsin stain, *see* Ziehl-Neelsen stain
- Carcinoma, *see also* names of organs
- Carcinoma differentiated from chancres 236
 - embryonal of testes with lymphoid stroma 421
 - squamous cell of renal pelvis 779
- Cardiovascular system effects of bladder neck obstruction on 322
- Carnation deformity of pyelogram in tumors of the kidney 790
- Catheterization technic of 92
 - technic of self-catheterization 94
 - with silk woven catheters 92
- ureteral 110
- Catheters 73
 - choice of 74
 - coude 73
 - double-elbow 75
 - elbowed 73
 - follow up 76
 - Lefort type 76
 - Phillips types 77
 - for females 74
 - hollow tipped 73
 - Nelton soft rubber 73
 - olive tipped rubber 73
 - passage of technic of 92

- Catheters—(Cath. ref)
 retention type technique of passage of 94
 rubber 73
 choice of size of 74
 for use in the female 74
 scale, 73
 silk woven, 74
 blunt, 75
 double elbow 75
 bow 75
 examination of 75
 ovary tipped, 75
 selection of size of 76
 technic of passage of 92
 spiral tipped, 73
 type of, 73, 74
 urethral, 80
 selection of size of 81
 type of 80
 urethral, metal, 76
 th. Beniqué curv. 76
 th. typical elbow 76
 th. Van B. en curv. 76
 Wheeler, 73
 with terminal opening 73
- Cebitis, pelvic, acute a complication of seminal
 inflammation, 362
- Cervicitis, treatment of 879
- Cervix, carcinoma of, cystoscopic picture of 838
 urologic complications of 838
 urethral and renal, 838
 urethral dilatation, 839
 urethral narrowing, 839
 diagnosis of 256
 smears from, technic of, 86
- Chancres, clinical characteristics of 252
 clinical course of 252
 diagnosis of 253
 dark field examination for spirochetes, 253
 infectious in incubation period 253
 differential diagnosis of 253
 from leishmaniasis, 253
 from carcinoma, 256
 from chancre, 253
 from folliculitis, 256
 from granuloma, 253
 from gonorrhea, 256
 from herpes, 253
 from perianthritides, 256
 from scabies, 253
 from syphilis, 253
 eroded, 251
 extragenital, 251
 of anorectal region, 252
 of finger, 252
 of lip, 252
 of nipple, 252
 of tongue, 252
 genital, 250
 classification of, 251
 Hemorrhagic, 251
 indurated papillary, 251
 interurethral, 253
 location of 255
 mental, 253
 mixed, th. chancre, 251
 number of, 253
 of cervix, 256
 of lip, 251
 of nipple, 256
 of tongue, 256
 perforation, 251
 pathology of 249
 teripod, 251
 soft, are Chancreoid
 ulcerated, 251
- Chancreoid, 260
 infectiousness of, 253
 complication of 263
 baby, 263
 lymphangitis, 263
 course of 263
 diagnosis of, 264
 differential diagnosis from gonorrhea, 185
 etiology 260
 Ducery bacillus, 260
 incubation period of 261
 infectious adenitis in, 263
 location of, 261
 mode of infection 261
 acute of 261
 pathology of 261
 prognosis of, 264
- Chancreoid—(C. ref)
 prophylaxis of 264
 treatment of 264
 cancerization, 263
 incision, 265
 types of 263
 inflammatory 262
 mixed, 262
 simple 262
 ulcerative 261, 262
- Charrière scale 2
- Children, renal function test 847
 urologic examination in, methods of 846
 methods of cystography 847
 cystoscopy 847
 radiography, 847
 urethral catheterization 848
 urology in, 846
- Chimney-sweep cancer of scrotum, 45
- Chordee, complication of acute gonorrhea 175
- Chorionepithelioma, 795
 of testes, 421
- Chyluria 420
 differential diagnosis from hydrocele, 419
- Chyluria 888
 non parasitic 890
 diagnosis, 890
 symptoms of 890
 treatment of 891
 parasitic form, 889
 renal origin, 889
 treatment of 890
 rography in, retrograde 889
 Silar, Lancroftin, 889
- Circumcision, anesthesia for 181
- Clitoris development of 10
- Cloacal membrane 10
- Coal tar workers cancer 425
- Coitus, causes of, cause of impotence 445
 interruptus, as cause of impotence 445
- Colles' cyst 42, 44, 46
- Complement fixation test for diagnosis of gonorrhea
 194
- Compressor urethral, 45
- Condens method for obtaining specimens of semen, 427
- Condylomata, 199
 acromata, see Penis, papillomata
- Conus asculoma, 56
- Corpora amylacea, 433
- Corpora cavernosa 48
- Costovertebral angle location of 18
- Coude catheter 73
- Cowper glands, 14, 60
 ducts of 44
 embryology of 14
 examination of, massage of 89
 physiology of 70
- Coryza, gonorrheal, in the newborn, 200
- Creatinine excretion test, of renal function, 143
- Crista urethralis, 12
- Cryptorchidism, incidence of malignant tumors in,
 408
 role of gonadotropic hormone of anterior pituitary
 in 403
 treatment of, 409
 endocrine, 409
 contraindications to, 410
 test as indication for 409
 operative 410
 orchidopexy 410
- Crushing disease differentiation from adrenal co-
 ticial neoplasma syndrome, 798
- Cyclopropene anesthesia, 148
- Cystadenoma, papillary malignant, of kidney 777
- Cystectomy total, anesthesia for 958
 complications of 960
 for cancer of the bladder 957
 indication for 957
 postoperative care 959
 preoperative preparation for 958
 technic of 959
- Cystin calculi, 747
- Cystinuria, relation to cystin calculi, 495

- Cystitis** 462
 acute 463
 clinical picture of 465
 diagnosis of 466
 fever in 466
 hematuria in 466 884
 pyuria in 466
 treatment of 466
 general methods 466
 causes of 462
 chemical 462
 electrical 462
 nonbacterial 462
 pyogenic, 462
 thermal 462
 tuberculous 462
 chronic diagnosis of 47
 hematuria in 884
 interstitial, in the female *see* Bladder female
 infections of non specific
 mucosa in 471
 symptoms of 472
 frequency, 473
 pain 473
 pyuria 473
 treatment of, 474
 causal, 475
 palliative 474
 local measures 474
 remedies to change reaction of urine and
 relieve pain 474
 trigonal 475
 with predominant involvement of the mucosa
 pathology of 471
 with predominant involvement of the submucosa
 and muscularis pathology of 471
 cystoscopic changes in, 468
 etiology of 468
 in female diagnosis of 827
 symptoms of 826
 in chronic urethrocystitis 826
 interstitial chronic in female diagnosis of 827
 urethrography and cystography as aid-
 828
 modes of infection in 462
 by descending route 463
 by direct extension 462
 by fistulae 463
 by hematogenous route 463
 by lymphogenous route 463
 by reflux 463
 by unclean instruments 462
 by urethrogenous route 462
 pathology of 468
 cystitis cystica and glandularis 469
 cystitis emphysematosa 469
 edema bullosum 470
 granular or follicular elevations 469
 granulomas 470
 leukoplakia 470
 ulceration 468
 predisposing factors in 463
 ulcerative 468
Cystography 126
 definition of, 126
 in children 847
 of diverticula of bladder 488
 of tumors of bladder 508
 technic of in examination for obstruction of the
 bladder neck 330
 with aid of air 129
 with aid of contrast (opaque) medium 127
 solutions for 127
 with aid of excretory urography 130
 with plain film (flat plate) 127
Cystometer, types of 525
Cystometrograms follow up 529
 in medico legal work 529
 in neurogenic dysfunction of the bladder 529
 in spinal cord diseases 529
 in spinal cord injuries 529
Cystometry *see also* Bladder pressure of intracystic
 measurement of
 constancy of data of 528
 in diagnosis of neurogenic dysfunction of the
 bladder, 525
Cystoscopes 103
 American, advantages of 108
 essential components of 103
 for adults 104
 for cystoscopy alone 106
 for urethroscopic examination and treatment
 105
Cystoscope—(Continued)
 for urethroscopy and unilateral ureteral catheteriza-
 tion, 105
 Nitze 103
 obturator of 103
 optical systems in 104
 sheath of 103
 telescope of 103
 varieties of 104
Cystoscopy 103
 and ureteral catheterization in children 848
 anesthesia for 107
 intravenous 154
 contraindications to 121
 important data requiring record in 163
 in diverticula of bladder 488
Cystostomy suprapubic in treatment of vesical cal-
 culi 801
Cystotomy suprapubic anesthesia for 150 948
 complications after operation 950
 during operation 950
 incision and subsequent steps 949
 position of patient for 948
 technic of 948
 drainage of bladder through cystotomy opening,
 950
 filling of bladder in 949
 primary closure 950
Cystourethroscopy, technic of 102
Cysts, parapelvic 674
 preputial 276
- D
- Decapsulation** of kidney *see* Nephritis treatment of
 surgical
Deferentitis, 374
Dehydration as result of obstruction of bladder
 neck 322
 definition of 156
Denonvillier's fascia, 44, 45 46 51
Detrusor muscle 38, 39
Diabetes as postoperative complication in urologic
 surgery, 1029
 functional bladder symptoms in 522
Diabetes insipidus enuresis in treatment of 872
Diathermy transvesical electrodes for 961
 for bladder tumors 960
 technic of 961
Diet's crisis differentiation from acute ureteral
 block, 573
Digital fossa, 56
Diotrast, as contrast medium for urography 120
Diversion, of urine from bladder, operations for 1015
Diverticulectomy care of ureter in 954
 combined intra and extra vesical technic of 953
 of the bladder technic of 952
 removal of bladder neck obstruction after or before
 operation, 954
Douglass operation for urinary incontinence in the
 female due to obstetric trauma 852
Dragon deformity of pyelogram in tumors of the
 kidney 790
Ducrey bacillus in etiology of chancroid 260
Duplay's operation for hypospadias 906
Dysuria definition of 155
 etiology of after middle life 309
 after middle life changes at vesical neck 309
 prostatic sources 309
 urethral sources 309
 vesical conditions 309
- E
- Echinococcus** effects on bladder 476
Ectopia vesicae, *see* Bladder, ectrophy of
Eczema of penis 289
Edema cerebral in glomerulonephritis treatment of
 806
Edema bullosum differential diagnosis of from tumor-
 of the bladder, 515
 of the bladder 470
Ejaculatory ducts anatomy of 42 60
 catheterization of under urethroscopic control 102
 urethroscopic aspect of, 101
Electrocoagulation endovesical 965

- embolism, pulmonary 1024
- embryology 3
 comparative 3
 of bladder 11
 of ejaculatory ducts, 15
 of glans penis, 14
 of kidney 3
- embryology of labia majora, 15
 of labia minora 15
 of ovary 8
 of penis, 14
 of scrotum, 14
 of seminal vesicles, 15
 of ureter 3
 of urethra, 11
 of vas deferens, 15
 of vasostasis, 15
- endocarditis, gonococcal, 196
- endocervicitis, gonorrheal chronic, 241
- endocrine glands, as accessory sex glands, 433
- endocrine glands, as factor of sterility 430
- endocrine glands, testicles, 430
- endometriosis, of the bladder 416
- endometritis, gonorrheal 241
- English scale for calibration of instruments, 72
- enureids, 869
 definition of 155
 diurnal, 869
 etiology of 869
 food habit formation, 869
 organic or physical dist. causes, 8 9
 sperm bilda, 869
 nocturnal, 869
 training of bladder as preven (f 870
 treatment of, 870
 atropine, 871
 baclofen, 871
 belladonna 871
 change of environment 873
 endocrine preparations 872
 retropituitary 872
 thyroid, 872
 general rules in, 870
 diabetes insipidus, 872
 medication 871
 of physical defects, 870
 proper nourishment 870
 psychotherapy 871
- epididymectomy term of 940
 volume of 940
- epididymis, 380
 aberrant ducts of 390
 aberrant aa, 56
 anatomy of, 56
 anomalies of 380
 as secretory organ, 473
 carcinoma of, primary 383
 cysts of, 56
 cause vasculature of, 56
 epithelium of 56
 function of 67
 in secretory 68
 in relation to sterility 432
 (Virchow's organ of 37
 tuberculosis of, 56
 hematogenous infection f 385
 hydrocele of 382
 infections of 382
 mode of infection, 382
 injuries of 382
 length of, 56
 malformations of 380
 of embryology 8
 operations on, 939
 epididymectomy 940
 epididymotomy 939
 radiography f 133
 regional secretion of, 67 432
 spermatozoa of 380
 tail of 56
 tuberculosis of 391
 clinical pictures of 39
 acute condition, 392
 chronic condition, 392
 diagnosis of 391
- epididymis—(Continued)
 tubercular f—(Contd. on)
 differential diagnosis of 393
 from acet enlargement f the epididymis and
 testes, 393
 from broad enlargement f the epididymis
 and testes, 393
 from gonorrheal and pyogenic epididymitis 393
 nodes of invasion, 391
 along lumen of vas, 391
 by way of lymphatics, 391
 hematogenous, 391
 pathology f 391
 route f involvement 391
 involvement f tunica albuginea, 391
 isolated primary in of eiment f testes 391
 treatment of 393
 in operable cases, 396
 non-operative general 397
 heliotherapy and radiotherapy 397
 indications for, 39
 tuberculosis, 397
 epididymectomy bilateral 397
 unilateral 397
 orchidepididymectomy bilateral 397
 orchidepididymectomy unilateral 397
 surgical, contraindications to, 396
 in adanced bilateral tuberculosis of the
 male genital tract 396
 in adanced general tuberculosis, 396
 tubule formation of 56
 tumors f 382
- epididymitis, con 387
 followed by chronic epididymitis, 388
 pathology of, 384
 symptoms of 388
 complicating acute gonorrhea, 181
 prostatic, 382
 seminal vesiculitis, 363
- epididymitis, chronic 386
 as sequel to cat epididymitis, 388
 differential diagnosis f from tuberculous epididymitis, 386
 etiology of 383
 catheterization, 388
 chronic posterior urethritis and cystitis, 388
 gonorrheal, acute, symptoms f 183
 differential diagnosis f from tuberculosis, 393
 incidence f 383
 urethral discharge in 183
 hematogenous, 385
 hematogenous, B. coli in, 385
 incidence of 382
 non-gonorrheal, 387
 pyogenic, differential diagnosis f from tuberculous, 393
 recurrent 387
 treatment f 212
 treatment f vasotomy in 372
 tuberculous, differential diagnosis f from chronic
 atrophic epididymitis, 386
- epididymotomy f gonorrhea 309
- epididymus, 279 907
 associated anomalies, 907
 balanic or atrophic type 279 290
 complete without exstrophy f bladder 280
 inconstancy with 907
 in female 317
 penile type 279 280
 with exstrophy f the bladder 279
- epiphoron 8
- erections, pathologic, 446
 pathologic, persistent erections, f Priapism
 pathologic, transitory erections, 446
- erector pinnæ, 967
- erythema, as cause f hematuria 880
- Ertel-Schiff cut-off for cystoscopy 107
- estrogenic hormone in treatment of gonorrhea in
 girls, 867
- ether anesthesia, 148
- ethylene anesthesia, 148
- lvpal for intravenous anesthesia 154
- examination of patient, in office 85
- external palpation of seminal vesicles, 90
 external 85
 f genitalia, 85
 inserted from female cervix and urethra 86
 inserted from male rectum, 85
 internal, 87

Examination of patient—(Continued)

external—(Continued)

- of prostate 88
- of rectum, 87
- rectal, 87
- massage of Cowper's glands, 89
- massage of seminal vesicles 89
- massage of the prostate 89
- milking of male urethra 86
- palpation of prostate 88
- palpation of seminal vesicles 89
- local 160
 - abdominal 160
 - cystoscopy 163
 - important data to be recorded 163
 - external genitalia 161
 - inspection of ureters and ureteral catheterization 163
 - palpation 160
 - rectal 162
 - urethral 162
- position of patient for examination of prostate and vesicles, 88
- routine of, 85
- rectal 87

Excretory duct, primary 5

Excretory system 3

- comparative development of 4
- in human embryo 4
- rudimentary form of 3
 - in annelids 3 4
 - in mammals 3 4
 - in man 4
 - in vertebrates 3, 4

F

Fascia Gerota's 19

- of perineum 44
- pelvic 44
 - and perineal 44
- perineal superficial, 46
- prerenal 19
- retrorenal 19
- Zuckerhant's 19

Fat paranephric (pararenal) 19

perinephric, 19

Female urology in 815

Fertility lowered etiology of diet in 439

- lowering of 438
- normal variations in degree of 438
- requisites for 428
- vitamin E as factor in 439

Fever therapy *see* Pyreotherapy

Fibrin calculi 748

Fibroma of kidney 774

Field block anesthesia, *see* Block anesthesia

Filaria bancrofti in parasitic chyluria 889

Filaria sanguinis hominis, causing chylocele 420

Finger chancre of 252

Fistulae umbilical urinary, 454

- ureterocervical treatment of 836
- ureterovaginal treatment of 836
- urogenital in female diagnosis of 835
 - history of patient 835
 - vaginal examination in 835
- etiology of 834
- symptoms of 835
- treatment of 836
- types of 834
- vaginal postoperative, treatment of 836
- vesicocervical 834
 - treatment of 837
- vesicocervicovaginal 834
- vesicointestinal in female treatment of 837
- vesicouterine treatment of 837
- vesico-ureterovaginal 834
- vesicovaginal 834
 - following obstetric trauma treatment of 836

Florence test for semen 435

Folliculitis chronic in gonorrhea 188

- differentiated from chancre, 256
- penoscrotal in gonorrhea, 184

Formalin cabinets 84

sterilizers 84

Frei test, for diagnosis of lymphopathia venereum 268

Frequency definition of term as applied to urination 135

Fulguration, endovesical, 965

Funiculitis, *see also* Vas deferens, infections of

- Funiculitis, acute, 374
- as complication of seminal vesiculitis, 363

G

Gallstone colic differentiation from acute ureteral block 573

Gallstones, differential diagnosis from renal calculi radiographic, 761

Ganglioneuroma, of adrenal glands 798

Genitals, female diseases of urologic complications of 838

- male tuberculosis of in children 861
- tuberculosis of, tubercle bacilli in, types of, 726

Genital fold, 7

Genital tubercle, 11, 12 14

Genitals external embryonic development of 14

- examination of, 161
- in office 85
- male 274
- tuberculosis of, 389

Genitals, male tuberculosis of age incidence of, 390

- etiology of predisposing causes 390
- predisposing causes general 390
- local 390
- mode of infection 389
- concomitant tuberculosis elsewhere 389
- relation of gonorrhea to recrudescence of 390
- relation to renal tuberculosis 390
- malformations of as cause of sterility, 441

Gerota's fascia 19

Giraldes organ, *see* ParadidymisGlans penis *see* Penis

Glans penis, embryology of, 14

Glass tests for diagnosis of gonorrhea 192

- Posner's three glass test, 192
- Thompson's two glass test, 192

Glomerulonephritis acute diffuse 804

- clinical course of 805
- etiology of 804
- pathology of 804
- symptoms of 805
- treatment of 805
- of cerebral edema with uremic like syndrome 806

focal 804

Goebel Frangenheim Stoeckel type of operation for urinary incontinence in the female due to obstetric trauma 834

Gonadotropic principles of the urine, 67

Gonads *see* Sex glands

Gonococcal infection extragenital, 198

- systemic 195
- incidence of 195
- complement fixation in 195
- sepsis cardiac complications 196
- transitory 195

Gonococcus as cause of gonorrhea 171

- strains of 171
- toxin of 172

Gonorrhea 169

- see also* Gonococcal infection
- acute active or florid stage 175
- complications of 177
 - chordee 175
 - differential diagnosis of 185
 - edema 184
 - epididymitis 181
 - intraurethral abscess 184
 - lymphangitis 184
 - penoscrotal folliculitis 184
 - perineurethritis and periurethral abscess 183
 - posterior urethritis 177
 - prostatic abscess 179
 - prostatitis 179
 - pylitis 185
 - seminal vesiculitis 180
- course of 176
- criteria of cure in 216
- differential diagnosis of 185
 - from balanoposthitis 185
 - from chancroid and phimosis 185
 - from chronic anterior urethritis and stricture 186
 - from chronic gonorrhea, 187

Gonorrhea—(Continued)

- acute—(Contn. ed)
 - differential diagnosis (—(C t. ed)
 - from chronic posterior rethritis, 187
 - from chronic prostatovesiculitis, 185
 - from intraurethral haemorrhage, 185
 - from prostaticitis and peritonsillaritis, 185
 - from subacute gonorrhea, 187
 - from urethritis, 186
 - from urethrorrhoea, 186
 - in female, 218
 - course of, 240
 - etiology of, 238
 - symptoms of, 238
 - incubation period of, 175
 - onset of, 175
 - symptoms of, 175
 - general, 176
 - local, 175
 - nocturnal, 175
 - pain on urination, 175
 - pain upon erection, 175
 - painful ejaculation, 176
 - proctosomal, 175
 - urgency, 175
 - treatment of, routine, 207
 - summary, 209
- anorectal, 199
- arthritis from, 196
- as mixed infection, 173
- chronic criteria of cure in, 217
- differential diagnosis from acute gonorrhea, 187
 - in female, 241
 - symptoms of, 188
 - treatment of, 214
- complications:
 - local, 173, 213
 - phimosis and paraphimosis, 213
 - condylomata acuminata in, 199
 - criteria of cure, in relation to marriage, 218
 - cure of, determination of, 216
 - duration of, 169
 - definition of, 169
 - diagnosis of, 165
 - complement fixation test, 194
 - glue tests for, 192
 - dot in, 203
 - endocarditis in, 196
 - etiology of, 170
 - etiology of gonococcus, 171
 - proliferating, 170
 - extension of, 169, 172
 - general considerations, 169
 - heart complication in, 196
 - hygiene in, sexual and personal, 202
 - hyperacute, 176
 - treatment of, 210
 - immunity in, 170, 238
 - in children, 864
 - in boys, 864
 - diagnosis of, 864
 - prognosis of, 865
 - symptoms of, 864
 - treatment of, 865
 - in girls, 865
 - complications, 866
 - course of, 866
 - diagnosis of, 866
 - technique of inoculation, 866
 - modes of infection, 865
 - pathology of, 865
 - prophylaxis of, 866
 - symptoms of, 866
 - treatment of, 866
 - combined local antiseptic and estrogen, 868
 - estrogenic hormone, 867
 - recurrences after, 867
 - local antiseptic, 867
 - protargol, 863
 - recurrences after, 868
 - silver picrate suppository, 868
 - sulfanilamide, 866
 - thelmin, 868
- in female, 218
 - complications of, 242
 - adhesions to bowel and omentum, 243
 - arthritis, 242
 - Bartolin's, 243
 - ectopic pregnancy, 242
 - haglund's adenitis, 242
 - peritonsillaritis, 243
 - peritonsillar, 242
 - pyomyoma, bilateral, 242
 - malpighia, 242
 - trigonitis, 242

Gonorrhea—(Contn. ed)

- female—(C t. ed)
 - determination of cure of, 247
 - diagnosis of, 243
 - etiology of, 238
 - in Skene's glands, 241
 - prognosis of, 244
 - sequela of, 243
 - in infection of, 241
 - treatment of, 244
 - cauterization, disinfection, surgery, 247
 - fever therapy, 244
 - sulfanilamide, 245
- joint in, 213
- myocarditis in, 196
- nasal, 200
- nervous complications in, 198
 - bone, 197
 - brain, 198
 - joints, 196
 - lungs, 198
 - muscles, 197
 - skin, 198
 - of, 198
- ophthalmia in, 198
- biology of, 174
- pericarditis in, 196
- period of decline, 176
- post-infectious sequelae in, 206
- proctitis from, 200
- prognosis of, 194
- prophylaxis of, 195
- pulmonary complication in, 198
- recurrences of, 189
- refraction and recurrence of, 171
- epitropia in, 196
- subacute, 177
- differential diagnosis from cutaneous gonorrhea, 18
- treatment of, 210, 214
- surgery in, 209
- epididymotomy, 209
- treatment of alkaline diuresis, 205
- antiseptic astringents, 206
- antiseptic, 205
- antispasmodics, 205
- astringents, 206
- uro-therapeutics, 208
- abstinence of sexual excitement, 203
- balms, 204
- bowel, 203
- broths, 205
- calcium chloride, 208
- camphor monobromate, 205
- capsules, 204
- cubeb, 204
- diathermy, 208
- diet, 203
- diuretics, 205
- elimination, 203
- exercise, 203
- general principles in, 201
- hydrotherapy, 208
- hygiene in, 202
- hyperpyrexia, 208
- in villous, 207
- internal, 204
- irrigations in, 206
- light therapy, 208
- local, 205
 - potassium permanganate, 206
 - silver nitrate, 206
- medical, 204
 - halide diuretics, 205
 - antispasmodics, 205
 - balms, 204
 - sulfanilamide, 204
 - methylene blue, 205
 - microscopical examinations of, 207
 - milk proteins in, 208
 - object of, 202
 - potassium permanganate, 206
 - protargol in, 206
 - rectal suppositories in, 208
 - sandalwood in, 204
 - sodium iodide, 208
 - intravenous injections of, 208
 - surgical epididymotomy, 209
 - anatomy, 209
 - thermotherapy, 208
 - retroscopy-endoscopy, 209
 - urinary antiseptics, 205
 - urotropin, 204
 - celery, 208
 - water in, 203

Gonorrhea—(Continued)

- transmission of, 170
 - by sexual intercourse, 170
 - to female, 170
 - to the newborn, 170
- types of, 176
- urethral stricture in, 222
- urine in, 191
- Gram stain, Burke modification of, 137
- Granuloma, differentiated from chancre, 255
- Granuloma, inguinale 265
 - diagnosis of, 267
 - etiology of 265
 - symptoms of, 266
 - treatment of, 267
- Gubernaculum, insertions of 403
 - role in cryptorchidism, 403
 - testis, 56
 - role of, 9
- Gumma, differentiated from chancre, 256
- Gynergen, in treatment of neurogenic dysfunction of the bladder, 531

H

- Heart, as affected by urologic surgery, 1023
 - diseases of, gonorrheal, 196
- Hemangioma, of kidney 775
- Hematocele 420
 - differential diagnosis from hydrocele 419
 - symptoms of 420
 - treatment of, 420
- Hematochyluria, filarial, 889
- Hematuria 880
 - appendiceal, 881
 - as initial symptom of bladder neck obstruction 325
 - causes of exertion, 880
 - genital male, 885
 - high protein diet, 880
 - lesions of adjacent structures 881
 - appendicitis 881
 - lesions of genito urinary tract 882
 - renal, 882
 - calculi 883
 - hydronephrosis, 883
 - infection of parenchyma renal pelvis and ureter, 882
 - lesions of renal papillae, 883
 - movable kidney 882
 - nephritis hemorrhagica, 883
 - polycystic kidney 882
 - tuberculosis of the kidney 882
 - tumors, 883
 - systemic, 880
 - erythemia 880
 - hemophilia, 880
 - Hodgkin's disease, 880
 - leukemia, 880
 - purpura hemorrhagica, 880
 - scurvy 880
 - tumors 884
 - ureteral 884
 - calculus 884
 - strictures 884
 - tumors 884
 - ureteritis 884
 - urethral 885
 - vesical 884
 - acute and chronic cystitis 884
 - adenoma and carcinoma of the prostate 884
 - calculus 884
 - simple and tuberculous ulcers 884
 - definition of 156
 - endemic, *see* Bilharziosis
 - in calculus, 755
 - in tumors of kidney, 782
 - menstrual, 882
- Heminephrectomy, technic of, 989
- Hemophilia as cause of hematuria, 880
- Henle's loop 26
- Hermaphroditism, 298
 - false, 298
 - female pseudohermaphrodites 300
 - male pseudohermaphrodites 299
 - true 298
 - various types of 298
- Hernia, complete inguinal reducible differential diagnosis from hydrocele 418
 - differential diagnosis of from hydrocele 418
- Herma—(Continued)
 - inguinal, as complication of arrested descent of the testicles, 406
 - complete, irreducible, differential diagnosis from hydrocele, and enlargements of testis, 419
- Herpes, differentiated from chancre 255
- Hiccup, postoperative, in urologic operations, 1029
- Hind gut, 10
- Hippuran, as contrast solution for urography 120
- History of patient, manner of recording, 157
 - chief complaint, 157
 - family history 159
 - general and local examination, 160
 - habits as to alcohol, coffee, tea, drugs, sexual life, etc., 159
 - inventory by systems, 158
 - mode of onset and course 157
 - previous illnesses, operations, etc., 159
 - sexual history, 159
 - venereal diseases, 159
- Hormone, male, 66
 - male, synthesis from cholestrin 67
- Hormone therapy in urology, amniotin, for treatment of gonorrhea in children, 867
- Hormone therapy in urology anterior pituitary extract, in treatment of cryptorchidism 409
- Hormone therapy in urology, antuitrin S, in treatment of impotence, 445
- Hormone therapy in urology, estrogen hormone in treatment of gonorrhea in children 868
- Hormone therapy in urology gonadotropic hormone in treatment of cryptorchidism, 409
- Hormone therapy in urology, pregnancy urine hormone, in treatment of cryptorchidism 409
- Hormone therapy in urology, retropituitrin, 872
- Hormone therapy in urology, theelin, in vaginitis 868
- Hormone therapy in urology thyroid extract in treatment of sterility, 441
- Hühner's postcoital test for sterility in the male, 428
- Hunner's ulcer *see* Cystitis, chronic interstitial, in the female,
- Hydrocele 414
 - acquired 416
 - differential diagnosis of, from congenital hydrocele 418
 - etiology of, 416
 - acute 416
 - chronic, 417
 - pathology of, 417
 - congenital, 414
 - diagnosis of 418
 - diagnosis of transillumination, 418
 - differential diagnosis of, 418
 - from hematocele 419
 - from hernia 418
 - from spermatocele 418
 - from tumors of testis, 419
 - hour glass, 414
 - mistaken for spermatocele 380
 - of cord, 414
 - of spermatic cord, 378
 - operations for 930
 - radical, 931
 - tapping, technic of, 930
 - prognosis of 419
 - terminology of, 414
 - treatment of, 419
 - aspiration followed by injection, 419
 - surgical, 420
 - tapping, 419, 930
- Hydronephrosis complications of, 665
 - hemorrhage into sac 665
 - infection 665
 - rupture spontaneous, 665
 - traumatic 665
- congenital, 623
 - etiology of anomalies of origin and termination of the ureters 532
- definition of, 662
- diagnosis of, 668
 - clinical history in, 668
 - retention test 670
 - urine 668
 - urography, 669
 - urologic examination, 668

- Hydrocephalus—(Cont'd)
 etiology of 662
 dynamic causes due to neurogenic dysfunction 664
 mechanical causes, 664
 in bladder 662
 in penis and urethra 663
 in renal pelvis, 663
 in ureter 663
 hematuria in, 833
 in movable kidney 657
 infected, pathology of 699
 pathology of, 664
 location of ectasi in, 664
 plastic operations for 1001
 relation to anomalies of lower polar vessel 644
 site of obstruction in, 1001
 surgical treatment of complication of 1003
 criteria of good result 1003
 plastic operations for 1001
 procedures for 1001
 technique of accurate approximation in 1003
 is abnormal mobility of the kidney 1002
 is badly infected cases 1002
 drainage in, 1002
 lateral anastomosis of the ureter and renal pelvis, 1004
 neptolysis and retrololysis, 1002
 plastics to enlarge lumen of ureter follow-up & reimplantation of ureter 1004
 resection of renal pelvis, 1004
 special features in, 1002
 ureterolysis, 1005
 symptoms of 667
 pain and hematuria predominant, 668
 pain and tumor predominant, 667
 renal infection mal feature 667
 silent cases, 66
 traumatic, 639
 treatment of, 670
 in bilateral cases, 670
 in unilateral cases 671
- Hypernephroma, see Adenocarcinoma papillary
- Hyperparathyroidism, factor in formation of calculi urinary tract, 495
- Hypogonadism, association with anomalies of position of testes, 408
- primary 408
 with predominance of adipose symptoms, 408
 with predominance of skeletal changes, 408
- Hypoplasia, 276, 280
 bilateral, 280
 in female 817
 penile 280
 perineal, 280
 surgical treatment of Beck operation 907
 Dupla operation, 906
 Fox-Jameson operation for 907
 preoperative treatment, 906
 division of ureter, 906
 penis straightened, 906
 technic of 906
- Ilium, differentiation from acute ureteral block, 53
 mechanical, as postoperative complication of rologic operations, 1028
 reflex, as postoperative complication of urologic operations, 1028
- Iliacocolic space, blood vessel of 969
 location of 18
 nerves of renal region 969
 topography of 967
 second, intermediate layer or plane 967
 superficial outermost layer or plane, 96
 third innermost transverse layer or plane 968
- Impotence, 444
 as cause of sterility 441
 etiology of 444
 functional causes, 445
 organic causes 444
 psychic causes, 446
 in diseases of spinal cord 433
 physiologic, 445
- Incontinence, functional following prostatectomy 521
 primary in epispadias, 907
 in female, 830
 anatomic considerations, 821
- Incontinence—(Cont'd)
 primary—(Cont'd)
 female—(Cont'd)
 etiology of 830
 extravesical causes 830
 vesical causes, 830
 symptoms of 831
 treatment of 831
 in cases due to ectopic end of ureter 83
 in cases due to obstetric trauma, 831
 Douglass operation 832
 Goebel-Franzenheim-Goeckel type of operation for 834
 Johnstone operation 832
 Kelly operation, 83
 plastics and tur for torn muscles 832
 substitution procedures, 834
 ribbon catgut in 834
- Indigo carmine test, separate renal function test 144
 total renal function test 144
 of renal function, via phthalein test 146
- Induratio penis plastica or Peni induration of fertility elati 439
- Infantal dermatitis, denopathy philline or Bubo, syphilitic
- Inhibition, 67 431
- Instruments, calibration of English and French scale
 equivalent, 73
 scales for 2
 abbreviations, 3
 America scale 2
 Bouquet scale 2
 Charrière scale, 72
 Lorich scale, 42
 Peters scale 72
 irrigators, 81
 retinal, 80
 urethral 73
 catheter 73
- Intestines, affected by urologic surgery 1028
- Invertebrates, excretory systems of 3
- Irrigators, 83
- J
 Janet method of irrigating post-ris urethra, 97
 Johnstone operation, for urinary incontinence due to obstetric trauma, 832
- Jones, et al for tubercle bacilli in urine 137
- K
 Kelly operation for urinary incontinence due to obstetric trauma, 832
- Kidney 16
 ectopic 683
 description of 683
 diagnosis of 683
 incidence of 683
 pathology of, 683
 symptoms of 683
 treatment of 684
 denoma of 774
 adrenal gland and, 6
 ampullary portion of 23
 anatomy of, parenchyma, 25
 pyelographic study of 23
 urinary tubules, 26
 anomalies of 589
 classification of 589
 concomitant anomalies, 624
 defects of the renal pelvis tract 624
 defect of the male genital tract 624 625
 urinary defects, 624
 congenital hydrocephalus, 623
 double kidney 617
 ectopia, 600
 extrarenal pelvis and calices 623
 horseshoe kidney 607
 hypoplasia, 595
 of blood vessels, 64
 of form, 599
 of location, 599
 of rotation, 616
 clinical aspects of 616
 of volume, 595
 solitary kidney 590
 unclassified, 624

Kidney—(Continued)

- arteries of 27
 - main renal artery, aneurism of, 647
 - etiology of, 647
 - false, 647
 - symptoms of, 647
 - true 648
 - symptoms and objective findings in, 648
 - treatment of 648
- perforation by calculi 753
- arteriosclerosis of, classification of, 801
- axis of 18
- 'bed of 19
- blood supply of 27
- blood vessels of 973
- see also Kidneys, arteries of
- accessory 28
- anomalies of 640
 - diagnosis of urography excretory and ascend-
ing retrograde 646
 - level of vascular obstruction in 645
 - of main vessels clinical significance of 642
 - polar and accessory main renal vessels 643
 - relation of lower polar vessels to hydrone-
phrosis 644
 - relation to surgical accidents 643
 - symptoms of vascular obstruction of the ureter
645
 - treatment of vascular obstruction of renal pelvis
and ureter in, 646
 - types of 641
 - incidence of 641
- embolism and thrombosis of, as cause of renal
infarction, 651
- fatal, 641
- perforation by calculi 753
- thrombosis as complication of tumor 781
- differentiation from acute ureteral block 578
- borders of 16
- calculi of see also Nephrolithiasis
 - analysis of 748
 - bilateral 750
 - treatment of 768
 - chronic pyelonephritic as chief feature 755
 - clinical pictures of 754
 - coincidence with renal, vesical and urethral cal-
culi 750
 - ureteral vesical and urethral calculi 750
- complications of 751
 - aneurism 754
 - anuria 879
 - fistula formation 752
 - perforation of main renal artery or vein 753
 - peritonitis 753
 - replacement lipomatosis 751
 - spontaneous rupture of the kidney, 752
 - tuberculosis 751
 - tumor 752
- coral or branching type of 750
- diagnosis of 756
 - blood chemistry in 763
 - cystoscopy and ureteral catheterization 762
 - examination of patient general, 757
 - history of patient 756
 - plain radiography locations of shadows of cal-
culi in renal anomalies 758
 - positive findings 758
 - supplemented by urography 757
- urography 759
 - causes of error in interpretation of 760
 - urologic examination 757
- differential diagnosis of, from biliary calculi radi-
ographic 761
- from biliary lithiasis by cholecystography 17
- radiographic and urographic 761
- hematuria in 883
 - microscopic or gross as chief feature 755
- in children 861
 - composition of 862
 - incidence of 861
 - localization of 862
 - mechanism of formation of, 862
 - sequels of, 862
 - treatment of 862
- incidence of 746
- initial lesions of Randall's research on 495
- mechanism of formation of 746
- multiple large 750
- physical characteristics of 746
- radiopacity of 757
- recurrence following operation prevention of,
771 772
- sex incidence of, 746

Kidney—(Continued)

calculi of—(Continued)

- site of 749
 - at outlet of renal pelvis 749
 - in a single major or minor calyx, 749
 - in parenchyma 730
- symptoms of acute pyelonephritic as chief fea-
ture 755
- anuria as chief feature 755
- pain as chief complaint 754
- intermittent or colicky, 754
- fixed 754
- treatment of 763
 - dietary acid ash diet 765
 - during quiescent period 765
 - in acute pyelonephritis syndrome 764
 - medical 765
 - indications for 765
 - mineral waters, 765
 - non surgical 765
 - of anuria 764
 - of pain 763
 - surgical contraindications to in bilateral cases
768
 - indications for 766
 - in bilateral cases 768 769
 - in calculi of both kidneys and both ureters
770
 - in calculi of both kidneys and one ureter
769
 - in calculi of both ureters 770
 - in calculi of one kidney and both ureters
769
 - in calculi of one kidney and opposite ureter
769
 - in calculi of one side only following re-
moval on opposite side 770
 - in calculi of ureter or kidney following
opposite nephrectomy 770
 - in unilateral cases 766
 - recurrence after 770
 - due to persistence of infection 771
 - due to persistence of pathologic changes
in the kidney, 772
 - due to stasis due to mechanical obstacles
or to neurogenic dysfunction, 772
 - etiology of 771
 - false 771
 - incidence of 771
 - prevention of 771 772
 - before during and immediately after op-
eration 772
 - postoperative care 772
 - dietary management 773
 - drugs and pelvic lavage 772
 - elimination of focal infection 772
 - radiographic surveillance 773
 - treatment of conditions favoring stasis
772
 - true 771
 - type of operation 768
- types of common 746
 - calcium carbonate calculi 747
 - oxalate calculi 747
 - phosphatic calculi 747
- rare 747
 - bacterial calculi 748
 - cystin calculi, 747
 - fibrin calculi 748
 - xanthin calculi 748
- calices embryology of 5
 - major 24
 - development of 5
 - minor 24
 - development of 5
- capsule fibrous 25
 - in relation to fatty coverings, 19
- carbuncle of 695
 - clinical picture of 701
 - diagnosis of urography retrograde, 702
 - treatment of 722
- carcinoma of 776
- color of 22
- cortex, development of 6
- cystadenoma, congenital see Kidney polycystic
- multilocular see Kidney polycystic
- cysts of parapelvic 674
 - solitary 672
 - diagnosis of, 674
 - urography, excretory, 674
- hemorrhagic, 673
- multilocular 674
- serous 672
- symptoms of, 674

- Kidney**—(Cont. and)
- cryst. of—(Cont. and)
 - solitary—(Cont. and)
 - treatment of 675
 - types of, 672
 - decapulation of, 811
 - dissolution of, 812
 - trachea f., 999
 - development of 3
 - degrees of see also under names of diseases
 - double, 617
 - anatomical considerations of 619
 - association with other renal anomalies 620
 - communication f. renal pelvis, 620
 - evidence of separation and size of tw. halves 619
 - relation of ureters and lateral orifices, 670
 - bilateral 618
 - clinical aspect 620
 - diagnosis of 620
 - of unilateral or bilateral type 621
 - incidence of, 619
 - symptoms of 620
 - treatment of, 622
 - unilateral 618
 - dropped see Kidney movable
 - dystopia of, 21
 - echinococcus f. 685
 - age incidence of 686
 - complications of, 686
 - diagnosis of 686
 - complement fixation test, 687
 - pre-operative, 687
 - incidence of 685
 - location of, 685
 - symptoms of 686
 - treatment of 687
 - dystopia of, congenital, bilateral, 601
 - clinical aspects f. 601
 - crossed, 603
 - anatomical considerations of 605
 - blood vessels, 606
 - direction in which hilum faces 605
 - genital defects, 606
 - length of kidney 605
 - mode f. origin and ending of ureters, 606
 - mode of union, 605
 - clinical aspects f. 606
 - diagnosis f. 607
 - incidence f. 604
 - sex incidence f. 604
 - sides affected in, 604
 - treatment f. 607
 - diagnosis of 601
 - lateral, 602
 - symptoms f. 602
 - during pregnancy or dystocia, 602
 - abnormal uterine and other abdominal conditions, 602
 - urinary tract symptoms, 602
 - unilateral, 599
 - anatomical considerations, 600
 - incidence of, 599
 - location of, 599
 - location of, iliac, 600
 - abdominal, 600
 - diaphragmatic, 600
 - lumbar 599
 - lumbar high, 599
 - lumbar low, 599
 - pelvic, 600
 - sex incidence of 599
 - sides affected, 599
 - embryology f. 2
 - extrarenal pelvis and calices, 622
 - fusion, 19
 - crossed section 19
 - horizontal section, 19
 - relation to peri- and pararenal fat layers, 19
 - size, in relation to infection, 20
 - incidence of 18 20
 - in normal subject, 654
 - form of 21
 - location of 61
 - acid base regulation, 62
 - excretory 61
 - via blood pressure, 61
 - non-excretory 62
 - test of, 119
 - blood chemistry 119
 - of separate function, 144
 - evaluation of results f. reoperative power of kidney factor in 146
 - indigo carmine test, 144
 - observed by polyuria, 146
 - phthalate test, 145
- Kidney**—(Cont. and)
- function of—(Cont. and)
 - theories on, 61
 - total tests of 140
 - test f., indigo carmine test, 144
 - phenolsulphophthalein test 140
 - fungus infection f. non actinomycotic 685
 - hematoma, perirenal 648
 - hila, anatomy f. 23
 - change of position during foetal life 7
 - direction f. 18 21
 - variation f. 21
 - location of 17
 - horseshoe, 607
 - topical relation f. 608
 - axial relation f. halves to spine 609
 - ureters and blood vessels, 610
 - parenchyma pelvis and calices, 609
 - size and relation f. the halves 608
 - reter 610
 - reticular strictures and kinks, 612
 - dystopia f. 615
 - opaque reticular catheters, 615
 - palpation, 615
 - plain radiography in, 615
 - urography 615
 - incidence f. 608
 - location and fixation f. 609
 - pathology f. 612
 - symptoms f. 612
 - due to pathologic condition in horseshoe kidney itself 613
 - Roux loop syndrome group, 613
 - treatment f. 616
 - hypertrophy f. congenital 599
 - hypoplasia f. congenital, 595
 - congenital anatomical considerations of 595
 - diagnosis of 597
 - cystoscopy and ureteral catheterization, 599
 - urography 597
 - ascending 597
 - histologic variations in 596
 - incidence f. 596
 - location f. kidney 596
 - morphology of 596
 - pathologic lesion f. 596
 - renal fusion on m. cases f. dysplasia, 598
 - pure hypoplasia, 598
 - see for 598
 - symptoms f. 597
 - toxemia f. pregnancy 803
 - fusion f. 651
 - diagnosis f. 52
 - prostatic 653
 - urography 653
 - due to embolism or thrombosis f. the main renal vessel 651
 - effect on kidney 652
 - etiology of 652
 - incidence f. 651
 - site of 651
 - in arteries or veins, 651
 - symptoms of 652
 - treatment of 653
 - fections f. as complication f. urologic operation 1020
 - second or 20
 - bacteriological findings 688
 - gram negative bacteria, 688
 - B. coli group 688
 - B. lact aerogenes or aerobacter 688
 - B. pyocyaneus, 688
 - bacillus proteus 688
 - gonococci, 688
 - typhoid and paratyphoid bacilli, 688
 - gram positive bacteria, 689
 - staphylococci 689
 - staphylococcus albus, 689
 - streptococci, 689
 - in pregnancy 842
 - clinical pictures 700
 - acute cases with localizing signs, 701
 - cut cases without localizing signs, 700
 - descending 20
 - diagnosis f. 700
 - cystoscopy 703
 - cystoscopy ureteral orifices, 704
 - transrenal focus f. infection, 703
 - examination for 703
 - in acute cases with localizing signs, 701
 - examination for 701
 - plain radiography and excretory urography 702
 - renal function tests, 703
 - ureteral catheterization, 702

Kidney—(Continued)

- infections of—(Continued)
 - diagnosis of—(Continued)
 - in acute cases without localizing signs, 700
 - catheterization 700
 - examination of the urine, 700
 - in infancy pregnancy and parturition 700
 - radiography and urography, 700
 - in chronic cases, with localizing symptoms 702
 - without localizing symptoms, 702
 - plain radiography 705
 - renal functional tests 704
 - ureteral catheterization and dilatation, 704
 - urine examination of 134
 - pelvic retention of, 704
 - residual, 703
 - urography ascending or retrograde, 705
 - excretory 705
 - hematuria in 882
 - in children 856
 - clinical pictures of, 856
 - fever 857
 - general symptoms, 856
 - diagnosis of, 857
 - urologic examination 859
 - predisposing causes of, 856
 - treatment of, 859
 - in acute cases 859
 - in chronic cases 859
 - in pregnancy 840
 - bacteriology of 842
 - clinical pictures of 842
 - in acute fulminating cases, 842
 - in mild cases, 842
 - latent 842
 - diagnosis of 843
 - in pregnancy etiology of 840
 - treatment of 844
 - control of effects of by blood culture 844
 - in puerperium 840
 - see also Kidney infections of in pregnancy
 - differentiation from puerperal sepsis 843
 - non tuberculous 688
 - pathology of 694
 - acute changes in pyelonephritis 694
 - hydronephrosis 699
 - in acute ascending urogenous and lymphogenous infections 694
 - in acute hematogenous infections 694
 - in carbuncle of the kidney 695
 - pyelonephritis 696
 - atrophic 698
 - pyonephrosis 699
 - renal changes 695
 - relation of intrarenal infection to perinephritic conditions 699
 - route of infection 690
 - hematogenous 690
 - lymphogenous 692
 - urogenous 690
- injuries of 626
 - diagnosis of urography excretory 636
 - non penetrating 626
 - changes in and around the kidney 627
 - penetrating 639
 - clinical pictures of, 639
 - diagnosis of 639
 - treatment of 640
 - sequels of 630
 - changes in the parenchyma and renal pelvis 630
 - perinephritic changes 631
 - traumatic hydronephrosis 630
 - subparietal 626
 - clinical pictures of 632
 - hematuria 632
 - pain 633
 - peritoneal irritation 634
 - primary shock followed by internal hemorrhage 634
 - rapidly increasing signs of internal hemorrhage 634
 - tumor formation, 633
 - complete division of vessels and ureter 630
 - complete or deep tears 628
 - complications of 630
 - concomitant injury of bony structure 630
 - concomitant injury of the peritoneum 630
 - injury of the intraperitoneal viscera, diaphragm and lungs 630
 - contusions of parenchyma 628
 - diagnosis of 635
 - hemitogenous infection of extravasated blood and urine in 628

Kidney—(Continued)

- injuries of—(Continued)
 - subparietal—(Continued)
 - mechanism of 626
 - by force exerted 626
 - indirect 626
 - of true capsule alone or of this and perinephritic fat 628
 - superficial tears of parenchyma, 628
 - symptoms of 635
 - temporary anuria, 636
 - treatment of, 637
 - expectant 637
 - surgical 638
 - indications for 638
 - with external wounds, 639
 - innervation of 30
 - direct fibers 31
 - direct vasomotor 63
 - from perivascular plexus, 31
 - from solar plexus 31
 - mode of penetration of nerves into parenchyma, 32
 - physiology of 62
 - secondary 31
 - location of 16
 - in relation to gallbladder 17
 - in relation to surface of the body 17
 - surface landmarks for 17
 - costovertebral angle 18
 - crest and anterior superior spine of ilium 18
 - illocostal space, 18
 - lymphatics of 29
 - median fusion of 607
 - medulla development of, 6
 - mobility of normal range of 654
 - mobilization of, operation for 977
 - movable 654
 - age incidence of 655
 - clinical picture of 658
 - chronic pyelitis in 658
 - with abdominal tumor as chief feature 658
 - with single or recurrent crises 658
 - diagnosis of 659
 - urologic study 659
 - etiology of 655
 - constitutional factors 656
 - nutrition pregnancy and tight lacing 656
 - splanchnoptosis 656
 - trauma 656
 - hematuria in 882
 - incidence of, 655
 - mechanism of migration 656
 - pathology of 656
 - changes in pedicle and ureter, 657
 - hydronephrosis, 657
 - pyelitis 658
 - sex incidence of 655
 - side affected 655
 - symptomless 658
 - treatment of 659
 - nephropexy, 659
- "miche" 25
- operations on 967, 973
 - accidents during 1006
 - bleeding from overlooked vessels to the poles of the kidneys 1006
 - bleeding from the renal pedicle, 1006
 - injury to the adrenal, 1008
 - injuries to the duodenum 1007
 - injury to the pancreas, 1008
 - injuries to the vena cava 1006
 - denervation of the kidney 999
 - general considerations 973
 - heminephrectomy 989
 - incision of abdominal wall in 974
 - for exposure of one half of horse-shoe kidney 975
 - for primary exposure of renal pedicle 975
 - W. J. Mayo modification of Israel incision 973
 - mobilization of the kidney 977
 - displacement of the colon 978
 - in presence of inflammatory thickening of perinephric fat 977
 - mobilization of last rib, 977
 - traction on lower pole, 979
 - mortality from infection, 1030
- nephrectomy 990
 - lumbar 990
 - subcapsular 995
 - transperitoneal 996
- nephrolithotomy 984
- nephropexy 986
- nephrostomy 985
- nephro-ureterectomy, 998

Kidney—(Cont'd)

- operations on—(Cont'd)
 - perinephrotic exposure of kidney 996
 - plastic operations for hydronephrosis 1003
 - position of patient for 973
 - preparation of the field, 971
 - pyelotomy 990
 - reaction of kidney 998
 - technic of 973
- pyelitis of bladder 1 hematuria 1 883
- pyelomyoma of 3
- capsule, 25
- Shrover capsule 23
- medulla, 25
- tumors of, 774
- pelvis of, see Kidney, pel 1
- peritoneal reflection, 23
- permanent development of 4 5
- physiology of 61
- pathologic presentation 1 6
- polycystic, 613
- Age incidence 1 676
- associated with solitary cyst, 677
- clinical pictures of 677
- chronic nephritis, 677
- enlarged kidney, in, 678
- pus as chief feature, 678
- symptomatic hematuria cases, 678
- symptomatic or latent cases, 677
- diagnosis of, 679
- urograph, 680
- urologic examination, 679
- etiology of, 6, 673
- hematuria in, 883
- sterility in, 676
- incidence of, 676
- pathology of, 676
- symptoms of, 678
- treatment of, 679
- in cases without complications, 681
- surgical, 681
- surgical indications for, 681
- position of changes during development 6
- radiography of, 123
- slough defect due to blood clot or inflammatory exudate, 123
- arrest of normal pyelogram, 123
- reproduction of incomplete 619
- reproduction of the pelvis and ureter, see Kidney, double
- relations to adjacent structures, 971
- anterior relations, 972
 - on left side, 972
 - on right side, 972
- peritoneal reflection, 973
- posterior relations, 971
- above twelfth rib, 971
- significance in renal surgery 971
- below twelfth rib, 971
- diaphragm, 972
- reaction of indications for 988
- technic of hemostasis, 989
- resection of, 18
- lucidity or excess of, 21
- rupture of, spontaneous 640
- transperitoneal as cause of secondary infection 1
- peritoneal theses and perinephritic b-cases, 716
- crosses of, 777
- renal arteriovenous, 811
- venous refluxes of 63
- size of, 21 22
- solitary 596
- anatomical considerations, 591
- bladder condition, 592
- blood supply, 592
- urinary tract, 591
- on side of ureters, 591
- on side of solitary kidney 591
- congenital, clinical aspect of, 592
- in cases of erroneous removal of solitary kidney 592
- in cases which were only diagnosed, 592
- in operated cases without anuria, 592
- diagnosis of, 591
- combination of hematuria, 592
- history 491
- radiography cystoscopy and ureteral catheterization, 593
- significance of enlarged kidney on one side, 593
- urography excretory 593
- retrograde, 593
- frequency, sex, and number of cases reported, 590

Kidney—(Cont'd)

- solitary—(Cont'd)
 - treatment 1 593
 - 1 cases with uria, 593
 - 1 cases without uria 593
 - result 1 594
 - structure 1 3
 - perinephrotic 595
 - supplementary lobe 1 594
 - support 1 1 normal object 654
 - survival of 23
 - syphilis 1 68
 - diagnosis 1 68
 - gonorrhea, 682
 - granuloma infiltration and diffuse pyelonephritis 682
 - examination of 6 2
 - treatment 1 6
 - tuberculosis 1 1 association with general tuberculosis, 723
 - lateral 745
 - 1 case picture of 1 11
 - bladder symptoms, 733
 - disturbances of micturition 731
 - frequency 31
 - post 282
 - hematuria, 733
 - 1 symptoms indicative of acute or chronic renal infection, 733
 - ma over kidney region 734
 - pa on kidney or ureteral colic 733
 - complication of lithiasis, 731
 - diagnosis 1 734
 - alimentary or amebic pyuria, significance of 740
 - chemical history analysis of 734
 - cultures compared to guinea pig inoculation 740
 - cystoscopy 736
 - examination for transrenal tuberculosis, 735
 - palpation 1 kidney and search for concomitant renal tuberculosis, 736
 - pl radography 737
 - renal infection, 736
 - ma as compared to cult res, 740
 - ma, cultures and guinea pig inoculation, comparison of 740
 - retard bacteria, 741
 - ureteral catheterization 736
 - urine examination 1 739
 - bacteriology, 739
 - hemical and microscopic, 739
 - urography ascending (retrograde) 739
 - cretory uria cases, 737
 - urologic study 1 735
 - hematuria in, 842
 - 1 children 859
 - chemical pictures 1 860
 - coincidence with nephrolithiasis, 860
 - incidence 1, 859
 - treatment 1 860
 - pathology 1 726
 - acute and chronic military form, 72
 - 1 chronic forms 727
 - caseocavernous types, 727
 - in early stage, 727
 - in more advanced stage 728
 - in terminal stage 729
 - involvement of fatty capsule in 710
 - occluded tuberculous ureteropelvic 729
 - disseminated nodular form 740
 - fibrous or indurated form, 730
 - tuberculous nephritis 710
 - pyelographic simulation 1 renal tumor 92
 - spontaneous healing of 743
 - treatment 1 742
 - non-surgical, 742
 - urgeal, complications of immediate postoperative 744
 - 1 postoperative, 745
 - postoperative cystitis, 745
 - indications for 744
 - nephrectomy complications of 744
 - contraindications to, 744
 - 1 bilateral cases, 745
 - mortality of 744
 - recovery, percentage 1 744
 - tumors of 724
 - see also Perirenal tumors and Retroperitoneal tumors
 - adenocarcinoma 777
 - adenoma, 774
 - associated with ancocele of spermatic cord, 380

Kidney—(Continued)

tumors of—(Continued)

- bilateral 780
 - carcinoma 776
 - clinical picture of 781
 - complications of, thrombosis of main renal veins, 781
 - diagnosis of 784
 - clinical history 784
 - cystoscopy and ureteral catheterization 788
 - examination for metastases 788
 - filling defects, 790
 - pain 787
 - palpation 788
 - pyelographic changes 790
 - retention pyelograms 790
 - significance of symptomatic varicocele 788
 - spider, dragon and carnation deformities 790
 - ureteropyelography 789
 - urography 789
 - chief changes 790
 - retrograde 790
 - urologic study 788
 - differential diagnosis of 786
 - list of tumors to be considered in 787
 - pyelographic 791
 - blood clot or inflammatory exudate in renal pelvis and calices 791
 - fever in 784
 - fibroma 774
 - hematuria in 883
 - in children 777 862
 - embryonal adenosarcoma 862
 - lipoma 776
 - malignant alveolar adenocarcinoma 777
 - classification of 776
 - embryonal adenosarcoma 777
 - in children 863
 - papillary adenocarcinoma 777
 - papillary cystadenoma 777
 - pathogenesis of theories of 776
 - preoperative irradiation of 794
 - indications for 794
 - Wilm's tumor 777
 - metastases from 780
 - in papillary adenocarcinoma and alveolar carcinoma 781
 - in papillomata, 780
 - skeletal 781
 - multiple 779
 - myoma 775
 - of parenchyma 774
 - benign 774
 - malignant 776
 - of renal pelvis 778
 - operation in 792
 - pain in 783
 - papilloma of 778
 - sarcoma 777
 - symptoms of fever 784
 - pain 783
 - neuralgic 783
 - tumor 783
 - treatment of 792
 - nephrectomy 792
 - contraindications to 792
 - found at operation 792
 - which can be recognized before operation 792
 - end results of 793
 - preoperative irradiation of malignant neoplasms 794
 - veins of 29
 - see also kidneys blood vessels of
 - weight of 22
- Kidney pelvis 23
- absorption from 65
 - adult, capacity of 25
 - ampullary 23 24
 - combined intra and extrarenal type 24
 - intrarenal 24
 - anomalies of, 623
 - bifid 24
 - extrarenal 24
 - development of 6
 - function of 63
 - tumors of papilloma 778
 - papilloma clinical significance of 779
 - squamous cell carcinoma 779
 - vascular obstruction of treatment of 646
 - walls of 25
- Kittering hypertherm 208

L

- Labia majora, embryology of 15
- Labioscrotal swellings 14
- Laboratory methods 134
- Lacunae of Morgagni see Morgagni crypts
- Latisimus dorsi 967
- Le Fort follow up catheter 76
- Leiomyoma 795
- Leukemia hematuria in 880
- Leukoplakia of bladder in cystitis 470
- Levidig's interstitial cells, 54
- Lentulus vulva 39
- Lipoma of kidney 776
 - perirenal 794
- Lips, change of, 251
- Litholapaxy contraindications to, 501
 - for vesical calculi, 500
 - technic of 501
- Lithotripsy see Litholapaxy
- Ittra glands, 14
- Ludwig's theory of filtration and concentration of urine 61
- Luer syringe 81
- Lungs as affected by urologic surgery 1023
 - massive collapse of as postoperative complication in urology 1023
- Lymphangioma, retroperitoneal perirenal, 795
- Lymphoma retroperitoneal 795
- Lymphopithia venereum 267
 - diagnosis of Frei test for 268
 - etiology of 267
 - incubation period of, 268
 - treatment of, 269

M

- Malecot catheter 74
- Malpighian body 3
- Malpighian corpuscles 8
- Mandelic acid in treatment of pyelonephritis, 710 711
- Marital habits as cause of sterility, 439
- Masturbation 443
 - effects of 443
 - excessive as cause of impotence 445
 - treatment of 443
- McCarthy cystourethroscope 101
- McCarthy foroblique panendoscope 102
- Meatitis differential diagnosis from gonorrhea, 186
- Meatotomy technic of, 899
- Megalopenis see Penis enlarged
- Megoureter congenital 856
- Mercier interureteric bar, 38
- Mesonephros, 3
- Mesorchium 7
- Mesothelium 7
- Mesovarium 7
- Metanephros 3
 - embryological development of 5
 - vascular supply of 5
- Methenamine in treatment of pyelonephritis, 710
- Micropenis see Penis arrested growth of
- Micturition mechanism of, theories on 63
 - physiology of 65
- Minor office technic 85
- Morgagni appendix testis 9
- Morgagni crypts of 14 44
 - urethroscopic aspect of 101
- Mortality postoperative in urology, 1022
 - gonorrhea of 200
- Müllerian duct 7
- Mumps see Parotitis
- Myocarditis gonococcal 196
- Myositis gonorrheal, 197

N

- Necrospermia 436
- Nelson soft rubber catheter, 73

- Nephropexy**, see Paravaginal
Nephrodesmia, see Urosiectia B
Nephrotomy lumbar technique f 990
 f adhesions are numerous but easily separated,
 992
 if incision is difficult or impossible & mobilize
 994
 if pedicle fairly long 991
 subcapsular technic f 995
 technique of 990
 transperitoneal, technique f 996
Nephritis hemorrhagic or **Hematuria**, causes f
 renal, nephritic hemorrhagic
Nephritis, acute is differentiation f 802
 albuminuria, 802
 chronic, differentiation from acute retinal blood
 573
 interstitial, see Nephritis, chronic, without edema
 with edema 807
 course f 809
 etiology of 804
 pathology of, 809
 symptoms of 808
 without edema, 809
 pathology f 809
 symptoms of 809
 treatment of 809
 classification of 801
 definition of 801
 incidence f 801
 inflammatory, classification of 801
 nephrotic, with edema 806
 diagnosis of, 807
 pathology of 806
 symptoms of 807
 treatment f, 807
 toxic, or pyelonephritis, 804
 treatment of surgical 811
 decapitation, 811
 dissection, 812
 neurectomy 812
 neurectomy 812
 removal of foot of infection, 812
 splenectomy sympathectomy and hysteron 812
 tuberculous, 730
Nephroptosis stage 5
Nephrophimosis, see also Kidney, calculi f
 concurrent with tuberculous, 731
Nephrostomy contraindications f hemorrhage pre-
 vention of 985
 hemorrhage during control of 985
 technic of 984
Nephroscopy 986
 indications for 659 986
 its use of last rib, 988
 its use of transabdominal sutures 987
 its utilization of fibrous capsule alone 987
Nephrosteroma, benign 811
Nephrosis, degenerative, classification of, 801
 quadrant, see Nephritis, subcut with edema
 toxic, 804
Nephrostone, J
 exploratory technic of, 985
 Caldwell method, 986
 Papan method, 986
Nephroterectomy technique of 998
 subtotal, 998
 total, 998
Nervi erigentes, or Nerves, pelvic
Neuroblastoma of adrenal glands, 797
Neurocytoma of adrenal glands, 797
Neurogenic bladder see Bladder neurogenic dysfunc-
 tion of
Neurosarcoma, see Sex neuromas
Neuritis, transmission of gonorrhea to, 170
Nipple, chancra of 252
Nitrous oxide anesthesia, 149
Nictaria, in gonorrhea, 175
Noce, gonorrhea of 200
Noel-Janssen operation, for hypopadias, 908
 anesthetic solution for spinal anesthesia, 153
O
Ovary as cause of sterility 429
Ovarian external mass 967
Ovary as term muscle 96
Obstetric trauma many incontinence as result f
 treatment f 831
Office technic minor 85
Office treatment technique f minor proceed res, 90
Oligosperm 436
Oliguria, reflex, 63
Oli ry tipped catheter 73
Ombredanne operation for hypospadias, 907
Ope r re tech le 895
Ophthalmia gonorrheal, in adults, 198
 maturation period f 198
Orchidectomy 941
 dissection f th electrocautery in, 942
 indication for 941
 technic f 941
Orchidopexy indications for 410 93
 technic f 93
 i created descent f the testicles, 93
 how re f the inguinal incision 938
 fixation f test 937
 mobilization of test 93
 steps of 932
 Tork method f preventing traction f
 test 937
 in f play or aberrant descent, 939
Orchitis acute 412
 secondary t mumps 41
 chronic 413
 pyohidrotic cut 413
 chronic 413
 interstitial 413
Osteofibroma, or Paget disease
Osteoperitonitis, gonorrheal, 197
Ovary embryology f 8
Oval t calculi 747
Ovarula 891
 symptom f 891
 treatment f 891
P
Paget disease differential diagnosis f from carci-
 noma of the prostate 351
Papilliform plexus, thromboembolic f 374
Pandoscope McCarthy's, 103
Papilloma, f renal pel vis, 778
Pallomata, of kidney 7 8
Paradidyma, 57 380
Paraganglioma, f adrenal glands, 798
Palsyria, respiratory as complication f palat abes-
 thesis, 153
Pseudophall fat infection, primary 20
Paraphimosis, 292
 gonorrhea, 213
 treatment f 291
Paramural infections, 715
Parsporen 8
Parotitis, complications f acute orchitis, 412
 atrophy of testicles, 411
Partica scale 72
Pedicularis, public, f acrot m, 427
Pelvic diaphragm, 44
Pelvic fascia, 44
Pelvic nerves, 42
Pelvis, abscess f acc Abscess, pelvic
Penis, absence f 275
 adherent 276
 amputation f 904
 low technic f 904
 technic f 904
 anatomy f 47
 angioma f 293
 anomalies f 275
 anterior portion of 47
 erect growth f 276
 blood supply f, 49
 body of 47
 carcinoma f diagnosis f 294
 differential diagnosis f 294
 etiological factors, 293
 nerveless, 293
 pathology f 294

Penis—(Continued)

- carcinoma of—(Continued)
 - squamous cell, 294
 - flat 294
 - papillary, 294
 - symptoms of, 294
 - treatment of, 294
 - of large primary tumors 294
 - of small primary tumors 294
 - radical operation for technic of 905
- cavernitis of, 292
- cellulitis of, 292
- circumcision of, 896
- cleft 276
- concealed 275
- constriction of, 282
- contusions of, 281
- corona of 47
- corpus spongiosum, 48
- coverings of 48
- cysts of 293
- diseases of, 288
- dislocation of 281
- distal extremity of, 47
- divisions of, 47
- double, 275
- eczema of 289
- edema of chronic 292
- embryology of, 14
- enlarged 276
- erectile tissue of 48
- fasciae of 46
 - Buck's 49
- fracture of 281
- free portion of 47
- frenulum of 47
- gangrene of 292
- glans of 47
- gunshot wounds of 282
- hair follicle infections of, 289
- herpes of 288
- incised wounds of, 281
- incurvation of, 276
- induration of 292
- inflammation of 289
- injuries of 281
 - denudation of 281
 - division of 281
- lipoma of 293
- lymphangitis of 291
- lymphatic supply of 49
- malformations of 275
- mechanism of ejaculation from 70
- mechanism of erection of, 70
- nerve supply of 49
- operations on 895
 - amputation 904
 - anesthesia for 150
 - circumcision 896
 - anesthesia of 897
 - bloodless cuff method 898
 - clamp and circumcision method 897
 - contraindications to 897
 - dorsal slit and circumcision 898
 - in bleeders 898
 - incision of the mucosa 895
 - indications for 895
 - methods of 897
 - preliminary dorsal slit 896
 - as preliminary to circumcision 896
 - technic of 895
 - radical operation for carcinoma 905
- papillomata of, 289
- treatment of 289
- perineal portion of 47
- physiological action of 70
- posterior portion of 47
- prepuce of anomalies of 276
- root of, 47
- sarcoma of 295
 - incidence and types of 295
 - treatment of 295
- scabies of, 288
- spongeitis of 292
- sulcus of, 47
- surfaces of 47
- syphilides of 289
- torsion of 275
- tumors of 293
 - as cause of sterility 441
 - benign 293
 - cysts of 293
 - horns of 293
 - varicosities of 295
 - carcinoma *see* Penis carcinoma of

Penis—(Continued)

- tumors of—(Continued)
 - complications of, 271
 - papillomata of, 289
 - sarcoma of, *see* Penis sarcoma of
 - war injuries of, 281
- Pentothal for intravenous anesthesia, 154
- Perabrodil, as contrast medium in urography, 118, 120
- Percolators 83
- Periappendicitis, gonorrheal, 243
- Pericarditis, gonococcal, 196
- Pericystitis 462
 - diagnosis of 478
 - mode of infection in 477
 - symptoms of, 477, 478
 - treatment of, 478
- Perinephritic capsule 19
- Perinephritis 715
 - anatomic considerations, 716
 - role of renal fascia 717
 - role of true or fibrous capsule of the kidney, 716
 - chronic, followed by invasion of perinephric fatty capsule 715
 - definition of 715
 - fibrosclerotic or fibrolipomatous 723
 - diagnosis of 723
 - treatment of 723
 - mode of infection of perinephric fatty capsule, 715
 - from appendiceal focus of infection 716
 - from pre-existing chronic pyelonephritis 715
 - from retroperitoneal and perirenal tissues 716
 - from transcapsular rupture of the kidney 716
 - hematogenous, 715
- Periorchitis, 414
- Periorchitis hemorrhagica 414
- Perineal fasciae and muscles 45
- Peripelvic cyst pyelographic simulation of renal tumor, 792
- Peripyelitis sclerotica 723
- Perirenal hematoma 648
 - clinical picture of, 650
 - diagnosis of 650
 - etiology of, 649
 - injuries and diseases of the kidneys, 649
 - systemic causes, 650
 - incidence of 649
 - symptoms of 650
 - due to retroperitoneal hemorrhage 650
 - gradually increasing mass in upper abdomen 650
 - pain 650
 - treatment of, 651
- Perirenal lymphatics injection of, as complication of urography, 119
- Perirenal sclerosis, *see* Perinephritis fibrosclerotic
- simulating pyelographic picture of renal tumor, 792
- Perirenal tumors, 794
 - benign 794
 - cystic 795
 - malignant, 794
 - of fibrous and fatty capsules 794
 - solid 795
 - unattached of the embryonal urogenital apparatus 795
- Peristalsis, ureteral, 64
- Peritonitis as complication of urologic operations 1028
 - gonorrheal, 242
- Periurethral abscess as complication of urethral stricture, 227
 - gonorrheal, 183
- Periurethral phlegmon as complication of urethral stricture 227
- Periurethritis chronic in gonorrhea, 188
 - differentiated from chancre 256
 - gonorrheal 183
 - at frenulum, 184
- Perivesiculitis 362
- Pezzar catheter, 74
- Phallus 11
- Phenolsulphonephthalein test of renal function, necessity for simultaneous blood urea determination 143
 - technic of 140
 - separate renal function 145
 - total renal function 140

- Pelvic follow-up catheter 7
 Penis, 291
 congenital, 276-291
 differential diagnosis from gonorrhea, 185
 from chancroids, 262
 in gonorrhea, 213
 infectious, 291
 treatment of 291
 Phosphate calculi, 747
 Phosphaturia, 891
 clinical features of 891
 in gonorrhea, 191
 temporary treatment of 891
 Pincus test of renal function or Phenylsulpho-
 phenylol test
 Physiology of genito-urinary tract, 61
 Pituitary gland, effect on sex glands, 433
 Pituitary gland, gonadotropic hormone f. re. 1
 cryptorchidism 401
 issues of in relation to sterility 433
 relation to sex gland and hormones, 6
 Pituitary, atrophy fatal at embolism in, 179
 Pituitary, atrophy 797
 Polycystitis, neurogenic dysfunction of the bladder
 in, 522
 Polytomy, 444
 normal, 444
 pathologic, 444
 treatment for 444
 Polyuria, definition of 135
 reiter, 63
 Pomer three glass test for diagnosis of gonorrhea,
 192
 Postoperative complications, in urology 1022
 bronchitis, 1023
 cardiac, 1023
 cerebral, 1022
 diabetic, 1029
 gastric, 1024
 hepatic, 1024
 high incidence of 1030
 reasons for, 1028
 Blow, mechanical, 1028
 reflex, 1028
 intestinal, 1028
 kidney infections, 1030
 peritonitis, 1028
 postoperative shock, 1028
 pulmonary 1021
 pulmonary embolism, 1024
 vomiting, 1025
 Pregnancy changes in upper urinary tract diseases
 dilatation, 840
 urographic demonstration of 840
 dilatation of upper urinary tract during pregnancy
 841
 mechanical, 841
 narrow, 841
 muscular atony 841
 Pregnancy, ectopic, of gonorrheal origin, 42
 renal infection in, 840
 histology of 842
 tumors of kidney in, 803
 calculus, of gonorrheal origin, 243
 Preoperative cautions, in urologic surgery 1031
 badly infected kidney, 1031
 acute nephritis, 1031
 food risk, 1031
 hematuria, 1032
 second infection, 1031
 Prostate, anatomy of 276
 cysts of 276
 etiology of in gonorrhea, treatment of 213
 Prostate, 447
 etiology of, 447
 treatment, 447
 Proctitis, gonorrheal in female, 4
 Proctitis, effect of 67
 in case of excision of the prostate effect of radio-
 therapy in tumors of the testicle 424
 quantitative determination of diagnostic test
 for determining type of tumor of the
 testicle 424
 Proctitis, effects of, 67
 Proctitis, 34
 Proctitis, see to 8 Hammanide
 Proctitis, see to 8 Hammanide
 Prostate gland abscess of a sequel to prostatitis, 303
 complicating gonorrhea, 179
 treatment of 211
 adenoma of hematoma 884
 anatomy of 49
 microscopic, 54
 normal 310
 anomalies of 301
 atrophy, complete or partial 301
 congenital cysts, 301
 ectopic, 51
 blood supply of 51
 calculi of 303
 corpora mylarea (significance of 30
 diagnosis of, 303
 differential diagnosis of, from carcinoma, 351
 from prostatic calculi, 351
 primary 30
 radiography of 303
 secondary 302
 symptoms of 303
 treatment of 304
 cancer of 51
 carcinoma of 343
 development of 344
 diagnosis of 349
 aspiration biopsy 350
 biopsy 350
 cystoscopy 350
 palpation, 350
 differential diagnosis of 351
 from chronic prostatitis, 351
 from Paget disease or osteitis fibrosa, 351
 from tuberculosis of the prostate 351
 from cystic phlegmon 351
 tension of, 343
 by congenity 345
 lymphatic, 345
 along seminal vesicles, 346
 along sides of rectum 345
 through lymphatics draining nodes of external
 and internal iliac basins, 346
 through lymphatics of femoral and inguinal
 nodes, 346
 perforated tissues 345
 hematuria in 884
 hypertrophy of the prostate in, 344
 incidence of 344
 metastasis from, 346
 by hematogenous route 346
 operations for, 921
 young radical perineal prostatectomy 921
 pathology of 343
 clinical significance of certain factors 345
 size of 349
 symptoms of 348
 treatment of 351
 palliative measures 352
 prostatectomy 352
 radiation, 352
 X-ray therapy 352
 types of 348
 embryology of 12
 examination of 89
 examination of palpation, 88
 position of patient for 88
 function of 89
 in relation to sterility 433
 hypertrophy of 308, 309
 see also Bladder, etc., obstruction of
 and carcinoma, 344
 bilateral 312
 and posterior commissural 313
 and subcervical or trilobe 313
 differential diagnosis of 330
 from tonic of the detrusor muscle 311
 from chronic prostatitis and calculus, 330
 from prostatic abscess, 331
 from prostatic calculi, 331
 from prostatic tuberculosis, 330
 from urethral stricture 331
 from vesical calculus, 331
 etiology of 309
 anal vesiculitis, 366
 intravesical 313
 median bar formation 315
 contractures of bladder neck in, 317
 pathology of 310
 size of 311
 solitary conchoidal median lobe or glandula
 in, 313
 solitary subcervical lobe 313

- Prostate gland—(Continued)
 hypertrophy—(Continued)
 subvesical 314
 surgical treatment of as indicated by blood chemistry and phthalcin test 338
 cystotomy for preliminary drainage, indications for, 341
 operative procedures, choice of 339
 types of, 339
 perineal prostaticectomy, indications for 341
 preoperative, 338
 suprapubic prostaticectomy indications for 341
 transurethral resection, complications of, 340
 hemorrhage, 340
 incontinence 340
 infection 340
 operative 341
 rupture of the urethra 341
 urinary extravasation, 341
 transurethral resection indications for 339
 types of, 312
 Randall's classification of 312
 as obstruction of bladder neck, 308
 infections of 304
 hematogenous 304
 lymphogenous 304
 pyogenic 304
 susceptibility to 70
 syphilitic 304
 tuberculous 304
 injuries of 301
 symptoms of 302
 hemorrhage 302
 urinary extravasation, 302
 treatment of 302
 lymphatics of 52
 nerves of 52
 operations on, mortality from infection 1030
 technic of 908
 transurethral resection technic of, 922 924
 sarcoma of 353
 age incidence of 353
 diagnosis of 353
 frequency of 353
 pathology of 353
 symptoms of, 353
 treatment of 353
 secretion of 69
 effect on sperm 432
 syphilis of 308
 tuberculosis of 307 309
 diagnosis of, 307 400
 diagnosis of from carcinoma of the prostate 351
 pathology of 307 399
 primary localization of 399
 route of infection in 307
 blood vessels 307
 ejaculatory duct 307
 symptoms of 307 400
 rectal 400
 urethrovesical 400
 treatment of, 307, 400
 tubules of 12
 embryonic development of 12 13
 tumors of malignant, in children 864
 veins of 52
 woody phlegmon of 303
 differential diagnosis of, from carcinoma 351
- Prostate glands, 50
 mucosal 50
 prostatic proper, 50
 subcervical lobe, 50
 submucosal 50
 suburethral 51
 trigonal lobe 50
- Prostatectomy, 908
 complications of 341
 epididymitis 387
 functional incontinence, 521
 late 920
 systemic 341
 for carcinoma of the prostate, 352
 perineal, anesthesia for 912
 indications for, in hypertrophy of the prostate 341
 Young's technic, 908
 drainage and packing, 912
 enucleation of lateral lobes 912
 enucleation of middle lobe, 912
 perineal incision 908
 sharp dissection, 909
- Prostatectomy—(Continued)
 suprapubic, 913
 complications of early local, 342
 epididymitis and seminal vesiculitis, 342
 hemorrhage 342
 wound infection, 342
 late local 342
 persistent fistula, 342
 persistence of symptoms 342
 recurrence after operation, 343
 systemic 341
 indications for, in hypertrophy of the prostate, 341
 one step 913
 hemostasis in 916
 technic of 914
 first step 915
 inspection of prostatic capsule 915
 two step, without intravesical inspection 917
 hemostasis and closure of wound in, 919
 postoperative care 919
 vasectomy as preliminary procedure in, 367
- Prostatic crystals, 71
- Prostatism, 366
- Prostatitis acute, 304
 sequel of prostatic abscess, 305
 symptoms of, 305
 treatment of, 305
 varieties of 304
 chronic 305
 diagnosis of 306
 rectal palpation 306
 differential diagnosis from carcinoma, 351
 symptoms of, 306
 discomfort 306
 nervous 306
 pain 306
 sexual 306
 urinary 306
 treatment of, 306
 diathermy 306
 injections 306
 massage 306
 complications, gonorrhea 179
 follicular with vesiculitis in acute gonorrhea, treatment of, 210
 gonorrheal symptoms of 179
 non gonorrheal 304
 types of 304
 routes of infection in, 304
 tuberculous 307
- Prostatocystitis gonorrheal, hyperacute 178
 with terminal hematuria, treatment of 210
- Prostatorrhea, differential diagnosis from gonorrhea 185
- Prostatotomy 926
 indications for 926
- Prostatovesiculitis 358
 as cause of sterility 440
 chronic differential diagnosis from gonorrhea, 18
 gonorrheal 188
 diagnosis of 189
 non infectious 366
- Pseudohermaphroditism, female, 300, 844
 male, 299
- Psoas major, 968
- Psychopathia sexualis, 446
- Puerperal sepsis differentiation from renal infection 843
- Puerperium, renal infections in 840
- Purpura hemorrhagica, hematuria in, 880
- Pus tubes, in male, 357
- Pyelitis cystica, 696
 gonorrheal 185
 granularis, 696
 in movable kidney, 658
- Pyelograms, ampullary, 123
 bifid 123
 carnation 790
 dragon, 790
 horn shaped, 124
 normal, 123
 pseudo spider, 792
 spider 790
- Pyelography *see* Kidney, radiography of
 as aid in study of anatomy 25

- Pyelonephritis, acute symptoms f i calcul 55
 treatment of 706
 examination to determine origin f 706
 & dehydration, 706
 general measures, 708
 local measures, 706
 surgical, indication for 07
 atrophic, pathology of 694
 atrophic changes in, 706
 chronic, nonatrophic, pathology of 696
 changes in renal parenchyma 694
 changes in the renal pelvis and calices 696
 leukoplakia, 697
 pyridyl cystitis, 697
 pyelitis granulosa, 696
 symptoms of in calculi, 755
 treatment f 08
 detritic, 709
 obstruction f foci f infection in 713
 injecting ureteral catheter pelvis in 11
 medication, 709
 nephroses, urinary diseases 71
 renal, 68
 acidosis, alkalimetric and end b diet
 708
 urosis in, 10
 ammonium chloride 710
 uro eyes, 710
 beta-oxylutylric acid 709
 mandelic acid 710 11
 mandelic acid, contraindication t 711
 methanamine 710
 pyridium, 710
 sulfanilamide (prontylin) 711
 urinary nitrophenols 710
 of curves of ure 713
 surgical, indication for 714
 nephrectomy 714
 nephrotomy 714
 vaccines and bacteriophage 12
 atrophic changes in, 706
 diagnosis of urography retrograde indication for
 703
 hypertonic treatment of see Pyelonephritis cut
 treatment f
 pathology of acute changes f 694
 hematuria, 694
 Pyelotomy anterior 980
 enlarged, 980
 technique of 984
 posterior 980
 difficulties encountered in, 982
 branches of the retroperitoneal vessel 983
 external versus intrarenal pelvis, 982
 fistula rotation of kidney 982
 peripneumonia, 984
 variations in length f renal pedicle 983
 technic of 980
 clonus 981
 drainage, 982
 Pyelonephrosis, reflux, as complication f urography 119
 Pyelonephrosis, bacteriuria in, 699
 complications of peritonitis, 699
 pathology of 699
 destruction of parenchyma in, 699
 sclerosis of the fatty capsule 699
 Pyeloplasty, bilateral gonorrheal, 242
 Pyelocystitis, as complication f acute seminal
 vesiculitis, 362
 treatment of 212
 Pyrotherapy in gonorrhea, 208
 in gonorrhea in the female 244
 Pyridium, in treatment f pyelonephritis 710
 Pyria, 835
 sarcoid, urographic changes in, 706
 definition of 156
 leukocyte count in urine method for 835
 sources of 836
 renal, 838
 perinephric, 836
 ureteral, 838
 renal 834
 clinical diagnosis of 837
 obstruction t bladder outlet, 836
 pyridic retention, 837
- Q
 Quadratus lumborum muscle 968
- Radiography of the urogenital tract 114
 also see names f organs and diseases
 arterio-phy 114
 ascending or retrograde radiography 118
 complication of 119
 combined, holoery urography 114
 to the phy 121
 combined contrast medium a d 6111 R 179
 contrast medium for 12
 with 11 f 1 129
 with d f opaque contrast medium 127
 ascending or retrograde urography 170
 f stages f 11
 dial f g f 121
 technic f 120
 pyelium 121 132
 urography f flow by retrograde ro-
 graphy 122
 in child 84
 method f 114
 jda radiograph 114
 area to be posed, 114
 position f pat t for 115
 preparation f patient for 114
 pneumourography 114
 pneumourography 797
 psycoscopy 114
 seminal vasculography phy 131
 f uroscopic exposures, 116
 retrograde normal 124
 retrograde phy 130
 urograms, interpretation f 123
 normal types 123
 urography solution for 118 120
 Radon seed implantation f 963
 method of implantation and removal in carcinoma
 of the bladder 964
 Radical classification f prostatic hypertrophies, 312
 Rajhe 14
 Record ymag 81
 Rectoscopes, 924
 Rectourethral muscle 44
 Rectum, amputation f 162
 in office 87
 stricture f gonorrheal 200
 Rjuvenation by testicular transplantation, 442
 Renal pt location f 18
 Renal pelvis, see Kidney pelvis
 Reproductive glands, see Sex gland
 Ret testis, embryology f 8
 Retention definition f terms as applied t uro-
 nomy 135
 Retroperitoneal, urethroscopic spect f 101
 Retroperitoneal tumors 794
 diagnosis of 796
 lymphangiosarcoma 795
 lymphoma, sarcoma t 795
 sarcoma, 796
 symptoms of 796
 see also Kidneys, tumors f and Perirenal tumors
 Retroproliferation in treatment f enuresis, 872
 Retrotrigonal fossa, 39
 Retrovesical tumors, 511
 Retrus, space f 40
 Rhinotomy for nephritis, 812
 Ribbon catheter, for treatment f urinary incontinence
 in female 834
 Rickets, renal 810
 Roaring syndrome, 613
- S
 Sacrospinale muscle 967
 Sarcocoma, see also names of organs
 retroperitoneal, 796
 Scabies, differentiated from chancre 253
 Scales, for calibration f instruments, see Instruments,
 calibration f scales for
 Scrotum, abscess f 425
 anatomy f 52
 anomalies f 424
 calcull f 425
 cutaneous affections f 426

Scrotum—(Continued)

- cysts of, 425
- eczema of, 427
- edema of, 425
- elephantiasis of, 426
- embryology of, 14
- emphysema of, 426
- fistulae of, 425
- gangrene of, 426
 - etiology of thrombophlebitis of pelvic plexus or veins, 426
 - primary, 426
 - treatment of, 426
- injuries of, 425
- intertrigo of, 426
- malformations of, 424
- operations on, 928
 - anesthesia for, 150
 - vasectomy, 930
 - vasotomy, 928
- physiological action of, 66
- regenerative capacity of, 66
- secretion of, 66
- syrphilides of, secondary, 427
- thermo-regulatory action of, 66
- tumors of, 425
 - chimney sweep cancer of, 425

Scurvy, hematuria in, 880

Semen, 71

Semen abnormal products in, 434

- composition of, 71
- corpora amylacea in, 435
- detection of for medicolegal purposes, Florence test for, 435
- examination of, 438
 - for diagnosis of sterility in the male, 434
 - in hanging drop specimen, 438
- methods of obtaining specimen of, 436
 - condom specimen, 437
 - ejaculated specimen, 437
 - expression of the seminal vesicles, 437
 - in prostaticorrhea and spermatorrhea, 437
 - masturbation, 438
 - puncture of testicle and aspiration, 436
- origin of, 434

Seminal tubules, proliferation of prostatic factor in, 67

Seminal vesicles anatomic variations of, 354

- anatomy of, 59
- anomalies of, 354
- as depots for spermatozoa, 432
- as foci of infection, 359, 363
- blood supply of, 59
- calculi and concretions in, 356
- embryology of, 8
- examination of massage of, 89
 - palpation, 89
 - bimanual, 90
- position of patient for, 88
- function of, 69
 - in relation to sterility, 432
- infections of, 357
 - mode of infection, 357
 - from epididymis, 358
 - from posterior urethra, 358
 - from prostate and rectum, 357
 - pathology of, 358
 - persistence of, 360
 - predisposing and associated conditions, 358
 - seminal vesiculitis, 360
 - site and extension of lesions, 359
- injuries of, 356
- malformations of, 354
- operations on, 926
 - vesiculectomy, 926
- position of, 59
- radiography of, 131
- secretion of, 69
- tuberculosis of, 357, 397
 - pathology of, 397
 - symptoms of, 398
 - treatment of, 400
- tumors of, 356

Seminal vesiculitis acute, clinical course of, 362

- complications of, 362
 - acute pelvic cellulitis, 362
 - epididymitis, 363
 - of funiculitis, 363
 - pelvic abscess, 362
 - provesiculosis, 362
 - strictures of the vas deferens, 363
- diagnosis of, 367

Seminal vesiculitis—(Continued)

- pathology of, 360
- symptoms of, 361
 - pain in, 362
 - ureteral colic, 362
 - urinary retention, 362
- treatment of, 369
 - and prostatic hypertrophy, 366
 - as complication of prostatectomy, 342
- chronic, 364
 - clinical course of, 366
 - diagnosis of, 368
 - differential diagnosis of, rectal examination in, 369
 - pathology of, 360
 - symptoms of, 364
 - cystitis, 366
 - neurasthenic, 365
 - pain along vas deferens, 366
 - phosphaturia, 364
 - prostatorrhea and spermatorrhea, 368
 - rheumatic, 365
 - sexual, 365
 - ureteral and renal colic, 365
 - urinary, 364
 - vesical albuminuria, 364
- treatment of, 369
 - diathermy, 370
 - dilatation, irrigation and instillation of posterior urethra, 370
 - massage, 369
 - neosalvarsan and sulphar-phenamine, 370
 - surgical, 370
 - aspiration of the vesicles, 370
 - catheterization and injection by way of ejaculatory ducts, 370
 - injection of Pregel's solution by rectal route, 370
 - surgical vasotomy, 371
 - vasotomy indications for, 372
 - vesiculotomy, 371
- complicating gonorrhea, 180
 - acute type, 181
 - hyperacute type, 180
 - subacute type, 181
- criteria of cure of examination of semen, 369
- diagnosis of, 367
 - hyperacute, 361
 - in association with prostatic hypertrophy, 367
 - similarity to acute prostatitis, 361
 - subacute, 364
 - diagnosis of, 367
 - treatment of, 369
- treatment of, 369

Seminiferous tubule, 54

function of, 67

Seminoma of testes, 421

Septis gonococcic *see* Gonococcic infection systemic

Septicemia gonorrheal, 196

Septuli testis, 55

Serratus posticus inferior muscle, 967

Sertoli cells, 54

Sex characters secondary effect of Prolin B upon, 67

Sex glands accessory, 12

in relation to sterility, 433

development of, 7

differentiation into male and female types, 7

role of endocrine factors, 14

table, 9

female embryology of, 9

male embryology of, 8

undifferentiated, 7

Sex neuroses, 443

Sexual function normal variations in, 443

Sexual life in male duration of, 443

onset of, 443

Shock postoperative in urologic operations, 1028

Sinus urogenital, 8

Skene's glands, 816

embryology of, 14

gonorrheal infection of, 241

treatment of, 247

Smears from female urethra technic of, 86

from male urethra technic of, 85

Sodium amylal for intravenous anesthesia, 154

bromide as contrast medium for cystography, 127

iodide as contrast solution for cystography, 127

- [illegible]

- Testicles—(Continued)
atrophy of, 411
etiology of, injuries to brain, 433
following mumps 411
blood supply of, 55
descent of, 9
embryology of, 8
enlargement of, differential diagnosis of from complete irreducible inguinal hernia and hydrocele of the tunica vaginalis 419
function of, endocrine 430
in relation to sterility, 430
spermatogenic, 430
effect of heat on 67
gumma of, 413
hormones of, 66
resistance to 67
infections of 412
injuries of, 411
length of, 55
lymphatics of, 55
position of 66
regenerative capacity of, 67
relation to pituitary gland 67
spermatogenic function of, 67
syphilis of, 413
diagnosis of 413
transplantation, for rejuvenation, 442
tuberculosis of, 392
tumors of, 420
chorionepithelioma 421
Prolan A excretion in urine in 424
classification of, 421
diagnosis of 423
diagnosis of, quantitative determination of Prolan A in urine as test for 424
differential diagnosis of 423
embryonal adenocarcinoma 421
embryonal carcinoma with lymphoid stroma 421
incidence of 420
malignant, in children, 863
treatment of 864
metastases from 421
abdominal sequelae of 422
by way of lymphatics of spermatic cord 421
by way of veins 421
to superficial lymph nodes 422
pathology of 420
relation to injury 422
relation to non descent of the testis 422
seminoma, 420
symptoms of, 423
teratoma adult cystic 421
Prolan A excretion in, 424
treatment of 424
irradiation of, effects of as measured by Prolan A excretion 424
undescended strangulation of 408
- Tests complement fixation test for gonorrhea 194
Tests, creatinine excretion test 140
Tests, Frei test for lymphopathia venereum, 268
Tests, glass tests, 192
Tests indigo-carmin test, 144
Tests, Kahn test 248
Tests Kohner test 248
Tests phenolsulphonephthalein test 140
Tests, phthalein test, 140
Tests, urea excretion test 140
Tests Volhard's concentration and dilution test 143
Tests Wassermann test 248
Theelin 431
in treatment of gonorrhea in girls, 868
Thompson's two glass test for gonorrhea 192
Thrombophlebitis gonorrheal 198
of pampiniform plexus, 374
Thymus gland persistence of, in relation to sterility 433
Thyroid extract in treatment of enuresis 872
in treatment of sterility, 441
Tongue chancre of, 252
Transversalis muscle, 968
Treponema pallidum, in etiology of syphilis 248
Trichomonas vaginalis infections of lower urinary tract in female 829
in male, 271
mode of infection 271
treatment of 271
- Trigone, absorption from, 65
anatomy of, 38
cystoscopic examination of, 109
embryology of 11
musculature of, 38
operations on 921
urogenital, 45
- Trigonitis, gonorrheal, 242
- Tubercle, genital, male, 14
- Tubercle bacilli, in urine, demonstration by inoculation of centrifuged urinary sediment on culture mediums 138
by inoculation of laboratory animals with centrifuged urinary sediment 138
in urine staining of, 137
Jones stain for, 137
Ziehl Nielsen stain for, 137
smears and cultures of, interpretation of, pitfalls in, 139
- Tuberculosis, *see* names of organs and regions
- Tubules, urinary of, kidney, microscopic description of, 26
- Tubuli recti, 54
function of, 67
- Tumors, *see also* names of organs and tumors
of adrenals, 797
of kidney, 774
perirenal 794
retroperitoneal 794
retrovesical, 511
- Tunica albuginea, 53
- Tunica, propria, 53
- Tunica, vaginalis, anatomy of 53
hydrocele of, differential diagnosis from complete irreducible inguinal hernia 419
- U
- Ulcer chancroid 261
genital, phagedenic chronic 269
etiology of 269
of penis, differentiated from chancre, 255
- U S Public Health Service treatment of syphilis 259
venereal, 260
- Urachus 11
carcinoma of primary invasion of bladder in 516
cysts of, 454
complications of 454
diagnosis of 454
treatment of 455
fistulae of, complications of 454
- Uraturia, 892
- Urea excretion clearance test of renal function, 143
- Uremia 803
chronic, 803
symptoms of, 803
- Ureteral bud, 5
- Ureter 32
abdominal, relation to other structures, 33
- Ureters anatomy of surgical 1008
anomalies of 535
blind ending ureters, 543
location of lower ends of, 545
varieties of 543
classification of 535
concomitant anomalies 624
congenital dilatation of, without mechanical obstruction 538
congenital diverticula 538
congenital kinks 539
congenital stricture, 535
congenital valves or folds 537
ectopic ending of ureter, 545
bilateral, 545
in the female clinical aspects of 546
in the male clinical aspects of, 546
incidence of, 545
inspection for, 546
by excretory descending and retrograde ascending urography 547
by injection of indigo carmine 546
by urethroscopy 547
location of endings and number of cases 545
unilateral, 545
of caliber and form 535
of origin and termination 541
clinical importance of 542
post-caval, 540

Ureters—(Continued)

- anomalies f—(Continued)
 - spiral twist or torsion, 539
 - occluded, 624
 - ureterocoele, 548
 - clinical aspects f 549
 - cystoscopic appearance f 549
 - involving both ureteral orifices f double kidney 549
 - treatment of 551
 - with pain of constant or recurrent type diagnosis f 543
 - with symptoms of hydronephrosis, diagnosis f 543
- blood clots of 35
- calculus of 566
 - age incidence f 567
 - bilateral, 567
 - clinical picture of 571
 - in acute pyelonephritis, 572
 - in acute ureteral block, 571
 - with both colicky and fixed pain, 571
 - with colicky pain, 571
 - with fixed pain, 571
 - in stricture, 572
 - in chronic ureteral block, 572
 - complications of 568
 - effect on ureter and perireteral structures 568
 - effects on kidney 569
 - in acute ureteral block, 570
 - in chronic ureteral block 570
 - composition f, 568
 - diagnosis of 572
 - clinical history 572
 - examination f urine 573
 - abnormal crystalline elements, 573
 - methods for 574
 - plain radiography 575
 - radiographic urographic and instrumental methods, in acute ureteral block)
 - drum, 574
 - in acute ureteral block syndromes, cut pyelonephritis syndrome, 574
 - in acute ureteral block syndromes calcareous stricture, 574
 - in acute ureteral block syndromes, colicky or fixed pain syndrome 574
 - urography excretory 576
 - retrograde, 576
 - retrograde examination, 573
 - wax-bulb catheter 576
 - differential diagnosis f cut ureteral block in, 573
 - from abdominal conditions, 573
 - from tubercular renal crises, 573
 - from urinary tract conditions, 573
 - form f 568
 - calculus of hematuria in, 584
 - localization of 566
 - number f 567
 - primary 566
 - secondary 566
 - sex incidence of 567
 - size of 566
 - surface f 568
 - treatment of manipulative cystoscopic methods, 579
 - intending to dilate the ureter 579
 - discussion of 580
 - for grasping and withdrawal of calculus, 580
 - manipulative removal f calculus, indications for 581
 - of acute ureteral block cases, 577
 - with cut pyelonephritis syndrome 578
 - with calcareous stricture syndrome, 578
 - with severe colicky or fixed pain syndrome 577
 - of chronic block cases, 579
 - surgical, indications for 581, 769
 - catheterization of 110
 - difficulties of 112
 - in children 848
 - obstructions to, 164
 - unilateral cystoscopes for 105
 - development f 111
 - dilatation of owing to obstruction f bladder neck 111
 - division f, 112
 - intramural portion 113
 - intra-portion, 113
 - pelvic portion, 113
 - ureterostomy f 163
 - character of flux 164
 - obstruction to catheterization, 164

Ureters—(Continued)

- function f 64
- granuloma f, 564
- implantation into bladder for diversion f 1016
- implantation into intact intestinal tract technique of 1017
- infections f 552 563
 - diffuse, 563
 - granuloma, 564
 - leukoplakia 564
 - localized, 563
 - routes f 563
 - symptoms, 564
 - ureteritis cystica, 564
 - ureteritis granulosa, 564
- injuries f 552
 - bilateral symptoms f 554
 - due to non-penetrating force, 552
 - due to penetrating force 553
 - treatment f 552
 - due to penetration by instrument 555
 - surgical 555
 - prophylaxis f 554
 - treatment of 554
 - unilateral, 553
 - diagnosis of level of 554
 - symptoms of early 553
 - late 553
- instruments for examination of 80
- leukoplakia f 564
- humer of variations in caliber f 33
- lymphatics f, 35
- nerves of 26
- operations on, 1008
 - anatomical considerations, 1008
 - diversion of urine from the bladder 1015
 - classification of 1015
 - intestinal implantation f ureters into intact intestinal tract, 1017
 - implantation f ureters into intestinal tract
 - Coffey technique f 1018
 - Coffey technique 1 Mayo modification f 1020
 - Coffey technique 2 1020
 - Coffey technique 3, 1020
 - Coffey technique, relative importance f three types f, 1020
 - Higgins method, 1021
 - intestinal 1016
 - non-intestinal 1016
 - retrograde transplantation to skin 1016
 - implantation f ureter to bladder 1016
 - essential points in exposure 1009
 - incisions for 1011
 - incision type 1012
 - Gibson modification of 1013
 - median with extraperitonealization f the bladder 1014
 - without extraperitonealization f the bladder 1014
 - pararectal 1014
 - mortality from infection, 1030
 - position of patient for 1014
 - ureterolithotomy 1014
 - ureterostomy 1015
- orifices f cystoscope localization f 103, 107
 - examination f 163
 - location of, 38
 - size and shape f 110
 - external, dilation of 966
- papilla f 33
- pelvic relation to other structures f female 15
- in male, 34
- peritubal f 64
- permanent)
 - development f 4 5
 - physiological function of 64
 - innervation 4 8
 - radiography f fleet f peritoneal filling of feet 113
 - link in normal ether 125
 - location f normal while rest or spasm 14
 - normal retrograde 124
 - implantation of in hydronephrosis 1004
 - relation to other structures 113
 - secondary)
 - structure of 536
 - sex incidence f 530
 - in location according to etiology 53
 - clinical picture 560
 - congenital 535
 - clinical picture f 536
 - diagnosis f, 536
 - treatment of 536

Ureters—(Continued)

stricture of—(Continued)

- definition of 556
- diagnosis of, 560
 - houghies, 560
 - ureteral spasm, 560
 - urography, 561
 - excretory, 562
 - retrograde, 561
- due to calculi, 558
- due to neoplasms and irradiation, 558
- etiology of, 556
- strictures of, hematuria in 994
 - incidence of, 558
 - inflammatory 556
 - location of, 559
 - preliminary considerations 556
 - muscle spasm, 556
 - normal levels of narrowing, 556
 - sex incidence of 560
 - treatment of, 562
 - dilatation, 562
 - for genital conditions 562
 - for renal tuberculosis, 562
 - removal of focal infections, 562
 - surgical 562
- structure of 35
- transplantation to skin for diversion of urine 1016
- tuberculosis of in children 861
- tumors of 582
 - age incidence of 584
 - diagnosis of, 584 586
 - by exclusion of other causes of obstruction to ureteral catheter 585
 - cystoscopic findings, 584
 - urography, 585
 - hematuria in 884
 - incidence of, 584
 - location of, 584
 - metastatic 583
 - primary 582
 - benign 582
 - malignant 583
 - secondary 583
 - symptoms of 584
 - hematuria 584
 - hydronephrosis, 584
 - pain, 584
 - treatment of, 586
- vascular obstruction of, treatment of 646

Ureterectomy as primary operation 1015

as secondary operation, 1015

technic of, 1015

Ureteritis cystica, 564

granularis 564

hematuria in, 884

Ureterocele, 548

clinical picture of 549

diagnosis of 549

treatment of, 551

Ureterograms, normal 124

Ureterolithotomy, technic of 1014

Ureteropyelography, in diagnosis of renal tumors 789

in differential diagnosis of bladder tumors 515

Urethra anatomy of 42

anomalies of 276

congenital stenosis of meatus 276

congenital valves of posterior urethra causing obstruction 848

treatment of in children 833

in children 848

anterior, 12

irrigation of 98

anterior meatus of injection of with hand syringe 98

bulb of, 44

bullet wounds of 283

calculi in 287

calculi of, coincidence with renal ureteral and vesical calculi 750

caliber of various portions of 42

caruncle of in female, 295

cavernous 12

chance of differential diagnosis from gonorrhea 185

crest of 43

curve of 42

cysts of 296

development of 11

diseases of 295

divisions of 42

Urethra—(Continued)

double 276

clinical aspects of, 277

diagnosis of, 277

incidence of 276

treatment of, 277

varieties of 276

examination of 162

cystourethroscopy 102

in obstruction of bladder neck, technic of, 329

false passages in, 282

fasciae of 44

female, 815

anatomy of 815

Skene's glands 816

anomalies of, 816

absence of urethra 816

congenital strictures 817

diaphragms or valves 817

diverticula 817

double urethra 816

epispadias 817

hypospadias, 817

carcinoma of 822

differential diagnosis of 822

symptoms of, 822

treatment of 823

coats of 816

diverticula of classification of, 818

diagnosis of 818

symptoms of 819

treatment of 819

divisions of, 815 816

embryology of 15

infections of 824

non specific 824

pathology of 825

predisposing causes of 824

length of, 815

lumen of, 815

prolapse of 819

symptoms of 819

treatment of 820

strictures of acquired 820

examination for 821

incidence of 820

treatment of 821

surgical treatment of, mortality from infection 1030

tumors of, benign 821

caruncles 821

fibroma 821

fibromyoma, 821

leiomyoma 821

papilloma 821

polyps, 821

treatment of electrosurgical resection 822

malignant, 822

adenocarcinoma 822

carcinoma 822

epithelioma or squamous celled carcinoma 822

papilloma, 822

fistula of 286

congenital urethrorrectal 287

foreign bodies in 283 287

gonorrheal invasion of, 173

injuries of 282

by direct violence, 283

diagnosis of 285

of bulbous urethra 283

of pendulous urethra symptoms of 284

of penile urethra 283

of posterior urethra, 283

prognosis of 285

treatment of, 286

instillations in technic of 96

instruments for examination of 73, 80

irrigation of technic of 97

length of 42

lymphatic supply of, 49

male 11

carcinoma of 297

age incidence of 297

incidence of 297

pathology of, 297

predisposing causes of 297

symptoms of 297

treatment of 298

diverticula of 278

acquired 278

classification of 278

congenital, 278

diagnosis of 278

incidence of 278

- [illegible]

